Annual Report
2020-2021

CSIR-Advanced Materials and Processes Research Institute, Bhopal

From Director's Desk

CSIR-Advanced Materials and Processes Research Institute (AMPRI), Bhopal is a constituent laboratory of Council of Scientific & Industrial Research, carries out advance research in frontier and multidisciplinary research areas of lightweight metallic and polymeric materials, smart and functional materials, advanced radiation shielding materials, cement free concrete, materials of biomedical interest and hybrid green composites towards industrial benefit for the masses.

During the last few years, this institute has special focus on the institute–industry amalgamation and commercialization of technologies through NDAs, MOUs and technology transfer. The sustained efforts in this direction have resulted in transfer of significant technologies for commercialization which include Lead Free X-Ray Shielding Tiles to M/s Prism Johnson Ltd Mumbai, Surface Plasmon Resonance (SPR) Raman substrates to M/s Technos Instruments Jaipur, Multifunctional Bamboo Composite Material for Modern Housing and Structures to M/s Permali Wallace Pvt Ltd Bhopal, Cement Free Concrete to M/s JSPL Raigadh, Hammer Tips for Sugar Mills to M/s Asugar Pvt. Ltd Pune, High Performance Hybrid Composite Materials to M/s Chauhan Fly Ash Products Ballarpur, Silicon Carbide Reinforced Composite to M/s Exclusive Magnesium Hyderabad, Hybrid Wood Substitute Composite Materials (CM-Wood) to M/s VSM Industries Pvt Ltd Surat, Advanced Hybrid Composite Wood and Wood Substitute Materials (AC Wood) to M/s Eco Bright Sheet Company Pvt. Ltd. Bhilai, Nano Alumina Adsorbent based Water Filter for Arsenic and Fluoride removal to Marcus Projects Pvt Ltd Lucknow, Defluoridation of Drinking Water using Nano Adsorbent based Domestic Filter, AMPRICARE - Sanitizer and Face Mask to M/s MSW Social Enterprises Pvt. Ltd. Indore, A novel process for making advanced radiation shielding materials for board application spectrum to M/s ASSURAYS Noida ,U.P., Evergreen hybrid composite of Parali-Agro waste and industrial waste to M/s Shubh Green Sheet Pvt Ltd, Durg, Chhatisgarh, Nanoadsorbent-Nano biocides based membrane filter for the removal of arsenic, fluoride, micro-organisms etc of drinking water to M/s IBS Water Nano Purifier LLP, Bhopal, AMPRICARE-Disinfectant Box (UV Rays Hybrid Technology) to M/s Apt Medical System Pvt. Ltd., Pune, Makeshift Buildings for Hospitals, Housing and other purposes to M/s Janta Tent & Events, Bhopal.

Further, the institute is progressing well in terms of quantity and quality of publications and patents.

Besides these, the Scientists of this Institute are very actively involved in mission mode activities for improvement of the livelihood of the society through various interactive programs, adoption of villages under CSIR-800 program, waste to wealth programme, skill development programmes and strategy for social development.

The dedicated team of Scientific, Technical and Administrative staff strives for achieving excellence and contribute to the needs of the industry, social sector and the Nation at large. We expect to keep this spirit high in the coming year also and make every effort to take CSIR-AMPRI, Bhopal to newer heights and to position it globally as a leading materials research laboratory.

Dr. Avanish Kumar Srivastava
Director

CSIR – AMPRI: An Overview

Advanced Materials and Processes Research Institute (AMPRI), Bhopal was instituted in May 1981 as "Regional Research Laboratory" (RRL) and officially started functioning from CSIR, New Delhi. The institute was then shifted to Bhopal and was located in Bhopal (now Barkatullah University campus). It subsequently found a place in the present premises in December 1983. The laboratory initially had about 15 scientists, with 10 of them specialized in metallurgy/materials science. This was the core strength of the institute at that time.

The institute initially undertook R&D on the synthesis and characterization of aluminium-graphite metal matrix composites and natural fibres. Gradually the scope of R&D broadened to include waste to wealth (building materials and wood substitute), mineral processing, environmental impact assessment, water resource modelling and problems related to agricultural, mining, sugar mill and thermal power plant machinery components. Health assessment, improvement and failure analysis of engineering components/systems and development of lightweight materials/components/products and processes for the automobile sector constituted other activities of significance. The work was extended with FEM simulation and modelling which became an integral part of the studies in many cases. Through its activities on water resource modelling, surface treated agricultural implements, bell metal artefacts, handicrafts using sisal fibre, use of fly ash for building materials and agricultural soil reclamation, etc., the institute became visible as a promising institute for rural technologies related to the specific problems of Madhya Pradesh.

The Governing Body of the Council of Scientific & Industrial Research renamed all its five Regional Research Laboratories (RRLs) to enable them to reflect a futuristic outlook. The changed profiles of the laboratories with respect to their direction of growth, orientation of expertise and accumulated excellence have all been weighed in while rechristening them. The name changed from Regional Research Laboratory, Bhopal to Advanced Materials and Processes Research Institute (AMPRI) with effect from March 6, 2007. In consonance with the new identity, R&D programmes in lightweight materials such as Al and Mg alloys, metallic and polymer-based composites, foams, and functional materials, microfluidics for point of care diagnostics, nanomaterials, new materials based on industrial wastes such as fly ash and red mud, and CSIR-800 projects of societal relevance have been undertaken. These programmes have an industry/user link from inception stage. A state-of-the-art processing and characterization facility and simulation modelling capabilities are being set up to trigger new materials development, innovations and improvements.

CURRENT PROGRAMMES AND FUTURE PERSPECTIVES

The present manpower includes scientists that are well trained in different disciplines of material science and other related areas along with supporting staffs. The number of scientists is planned to increase in the near future in view of the widened range of R&D activities. AMPRI is equipped with modern facilities for material synthesis, processing and property characterization such as SEM, HR-TEM, pressure die casting machine, semisolid processing unit, rolling mill, Mg melting unit, FESEM, Electromagnetic forming/joining unit, cryomilling unit, DTA, XRF, FT-IR, Raman Spectrophotometer, X-ray attenuation testing machine, electrochemical analyzer, UV-Visible spectrophotometer, AAS and those related to nanoscale R&D have been added in past few years.

The current activities of AMPRI are broadly categorised under:

- **Lightweight Materials**
- **Nanostructured Materials**
- **Smart and Functional Materials**
- **Integrated Approach for Design and Product Development**
- **Waste to Value added Materials**
- **Jigyasa and Skill Development Activities**

In the category of lightweight materials, important activities are related to Al metal matrix composites, polymer matrix composites, Al foam and Mg-based alloys. CSIR-AMPRI has laid a major emphasis on lightweight materials development like Al foam, Mg-based alloys, *in-situ* MMCs and nanostructured materials. Also, activities on electromagnetic forming, smart and functional materials, steel and Ti foams, and materials modelling and design are being carried out since the last 12^{th} Five-year Plan.

Under the research theme of nanostructured materials, lab is constantly working for the development of nanostructured material for different applications like nano-adsorbent, capacitor application, energy related areas, for sensors etc. Under this theme the lab has already established a process for the bulk scale synthesis of nanoalumina by a cost-effective process. The developed nano adsorbents possess significantly high fluoride and arsenic adsorption capacity. The sediment domestic water filter device has also been developed using this nanoalumina and the know-how is transferred to the industries.

Institute is employing integrated approach for design and product development in the area of shape memory polymer composites, natural fibre polymer composites, hierarchical carbon fibre reinforced composites, graphene-metal composites, coating materials, metallic foam, sandwich panel and metal matrix composite, brake drum component, bamboo composites etc. Advanced techniques like 3D surface scanning, 3D printing and selective laser melting processes, CVD techniques, micro compounding of nano-materials with smart polymers, universal bamboo shaping machine, design & analysis software, advanced characterization equipments are being used to develop products and processes. A dedicated team of scientists and technical staff along with students and project staff are working coherently to contribute significantly in S&T advancement.

In the area of Waste to Wealth, the institute is mainly engaged on the utilization of fly ash and red mud. The institute has developed wood substitute technology using red mud, fly ash and natural fibres and has potential applications for making doors, panels, partitions and furniture. CSIR-AMPRI has developed radiation shielding materials from red mud and holds a US Patent on the work. The potential applications of this technology are for the shielding of gamma and neutron in nuclear power plants and for diagnostic X-ray shielding in X-ray and CT scan rooms. This material has been started for use by the hospitals to shield diagnostic X-rays.

CSIR-AMPRI has worked on various rural development and dissemination activities which will have large implications for CSIR-800. The institute has taken up a project under Rural Sector Projects – Sisal Fibre Technologies for Rural Employment Generation. Sisal plant produces the hardest vegetable fibre which will have applications in cordage and handicrafts. The yarn and textile made out of this fibre is used for making composites for applications in sectors like housing, automobile, geotextiles, etc.

CSIR-AMPRI is actively engaged in microfluidic electrochemical & fluorescence-based biosensors which have recently been advanced for portable point-of-care diagnostics by integrating lab-on-a-chip technology and electrochemical analysis. Institute have developed several automated procedures for electrochemical detection of biomarkers, pharmaceutical and environmental samples using micro liquid, capillary gas chromatographic and capillary electrophoretic separation techniques and micro-chip-based separation under the concept of lab-on-a-chip. The microfluidic electrochemical & fluorescence-based biosensors approach offers a new platform for a rapid, miniaturised, and sensitive diagnostic sensor in a single device for various human diseases.

The overall objective of AMPRI is to achieve a world-class status in the area of engineering materials, components and process development. Accordingly, the HR Profile and S&T infrastructure aims to address the needs of both fundamental and applied research, technology development and business development in the area of materials of the future. The present resource base being created would not only provide commercial tractability for the present but also provide a root for more lucrative, elite and innovative areas for the future. It is envisaged to make the institute a place of pilgrimage for top material scientists and the stakeholders.

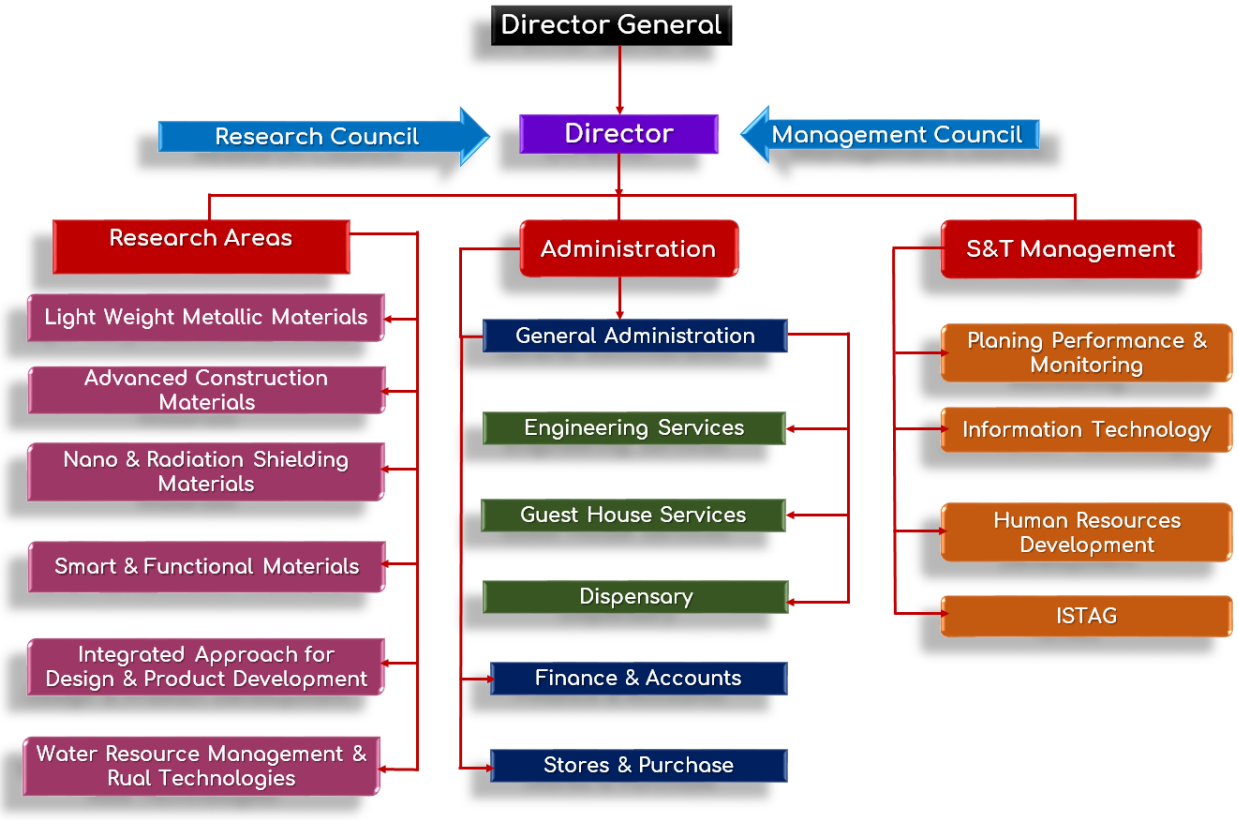
Vision

CSIR-AMPRI, Bhopal is committed to develop innovative, cutting edge, internationally competitive, energy efficient and environmentally friendly technologies /products in the area of advanced materials for societal benefits and to contribute to the Nation's Economy.

Mandate

- Research & Development on Engineering Materials for Strategic, High Performance and Societal Applications
- Materials, Processes and Technology Development for Component/Products for a variety of engineering materials, including Metals & Alloys, Composites, Polymers, Building Materials and materials from Waste to Wealth
- To undertake consultancy, sponsored, grant-in-aid, network & other national, international projects for both public and private sectors in above areas.

Organization Chart



Research Council

Prof. Shreekant Lele Former Professor, Department of Metallurgical Engg.,Indian Institute of Technology (Banaras Hindu University), Varanasi	**Chairman**
Prof. N.Ravi Shankar Department of Materials Research Centre Indian Institute of Science, Bangaluru	**External Member**
Prof. Shampa Aich Department of Metallurgical and Materials Engineering Indian Institute of Technology, Kharagpur	**External Member**
Er. Udayan Pathak Head & Deputy General Manager World Class Quality Engineering Research Centre, Tata Motors – Pune	**External Member**
Dr. Dheepa Srinivasan Chief Engineer Pratt and Whitney R&D Center IISc United Technologies Corporation India Pvt. Ltd., Bangaluru	**External Member**
Shri Vilas Tathavadkar Senior Vice President Aditya Birla Science & Technology Company Ltd., Navi Mumbai	**External Member**
Dr. K. Gopinath Programme Director Metallurgical Research Laboratory, Hyderabad	**Agency Representative**
Dr. S. Manjini Associate Vice President Technical Services & BusinessExcellence JSW Steel Ltd., Tamil Nadu	**DG's -Nominee**
Prof. Suddhasatwa Basu Director CSIR-Institute of Minerals and Materials Technology, Bhubaneshwar	**Sister Laboratory**
Dr. R.M. Mohanty Principal scientist Technology Management Directorate (Socio-economic Ministry Interface), CSIR-New Delhi	**CSIR Hqrs. Invitee**
Dr. Avanish Kumar Srivastava Director CSIR-Advanced Materials and processes Research Institute, Bhopal	**Member**
Dr. Satish Kumar Director National Institute of Technology, Kurukshetra, Haryana	**Special Invitee**
Dr. S.K.S. Rathore Sr. Principal Scientist CSIR-Advanced Materials and Processes Research Institute, Bhopal	**Secretary**

Management Council

Dr. Avanish Kumar Srivastava	Chairman
Dr. Ranjana Aggarwal, Director CSIR-NIScPR, New Delhi	Member
Dr. DP Mondal, Cheif Scientist, AMPRI	Member
Dr. SKS Rathore, Senior Principal Scientist, Head PPD & BD	Member
Dr. JP Shukla, Sr. Principal Scientist, AMPRI	Member
Dr. Sarika Verma, Principal Scientist	Member
Dr. Manoj Kumar Gupta, Scientist AMPRI	Member
Shri Anup Khare, Technical Officer AMPRI	Member
Shri Dheeraj, F&AO, AMPRI	Member
AO AMPRI	Member-Secretary

Ongoing & Completed Project

List of ongoing Projects:

CSIR Funded MLP/NWP/HCP/NCP/FBR/FTT/FTC

Sl. No.	Title of the Project	Project Code	Date of Start	Date of completion	Project Cost (Rs. In lakhs)
1	Development of special radiation shielding materials	MLP0201 (NCP-4M)	18/09/2020	31/03/2022	100.00
2	Design and Development of smart, hybrid polymer composite and structures for advanced engineering applications	MLP0202 (NCP-4M)	18/09/2020	31/03/2022	50.00
3	High strength creep and corrosion resistance Magnesium-RE-TE Alloy, composite and foams for Engineering and strategic sectors	MLP0203 (FBR-4M)	08/10/2020	31/03/2022	50.00
4	Advanced protecting of magnetic storage and Bio-Medical System using Smart thin file materials	MLP0204 (FBR-4M)	11/09/2020	31/03/2022	70.00
5	Bio-inspired surface functionalization of carbon nanostructures with catecholamine/catechol rich polymers; Novel approach to develop advance Biosensors	MLP0205 (FBR-4M)	17/09/2020	31/03/2022	50.00
6	Development of polymer/geopolymer based nano-composites for antimicrobial coating applications	MLP0206 FBR-CIE	30/12/2020	29/12/2023	64.490
7	Development of 3D printer for additive construction of scaled model of building and construction material optimization	MLP0207 (NCP-CIE Theme)	08/01/2021	07/01/2024	147.800

8	Synthesis of Zeolites from fly ash for agriculture applications	MLP0208 (FBR-ANB)	12/02/2021	31/03/2023	43.315
9	Development of Bamboo Composite Beams and their specification for engineering applications	MLP0210 (FTT-ANB)	03/09/2020	31/03/2022	120.000
10	Light weightAluminum hybrid foam coremulti layer sandwich panels with metal/3D carbon fiber/kevlar as face sheets for aerospace, blast resistance and transportation applications	MLP0211 (FTT-AEISS)	08/10/2020	31/03/2022	115.000
11	Light weight Aluminum Alloy Matrix composites for automobile, defence and Engineering applications	MLP0212 (FTT-4M)	13/01/2021	31/03/2022	75.00
12	Development of advanced non-Toxic radiation shielding material from tailored Brine sludge	MLP0213 (4M)	08/01/2021	31/03/2022	65.000
13	Development of Advanced materials and devices for opto, electronic, bio medical and strategic applications.	HCP030 - AMM - Mission Mode Project)	07/08/2020	30/06/2023	197.370
14	CSIR Integrated Skill Initiative –Phase II	NWP0100 (Skill Initiative Phase- II)	25/01/2021	31/03/2025	223.6
15	Application of Carbon dots as growth enhancers in agriculture system	MLP0049 (FBR-ANB)	11/01/2021	31/03/2023	88.890
16	Real-time portable electrochemical sensor array for simultaneous detection of antibiotics and pesticides	HCP031 (Food Mission)	04/02/2021	31/03/2023	74.545

Grant in Aid Projects (GAP):

S.No.	Title of the Project	Project Code	Name of Sponsor	Date of Start	Date of completion	Project Cost (Rs. In lakhs)
1	Light weight foam as an electrode for Lead acid batteries	GAP 0082	DST	27/09/2016	05/05/2022	83.00
2	Morphology controlled copper sulphide decorated with graphene sheets as an electrode material for Na-ion capacitor in aqueous and non-aqueous electrolytes	GAP 0092	SERB, New Delhi	13/03/2019	12/03/2022	39.945
3	Development of joining process for industrial components through electromagnetic forming	GAP0093	DST	24/05/2019	23/05/2021	49.40352
4	Hydrogen Powered desalination system using recycled aluminum: A novel process to extract potable fresh water from sea water (joint project with CIIRC-Jyothy Institute of Technology)	GAP0095	DST, New Delhi	20/03/2020	19/03/2023	50.35737
5	Electrochemical additive manufacturingprocess for sculptures, statues and decorative arts applications	GAP0096	DST	16/04/2020	15/04/2023	69.09753
6	Development of experimental setup for investigation, recording and testing of electromagnetic signals from magnetic photons in homeopathy medicines and other test samples	GAP0098	Govt. Homeopathic Medical College & Hospital, Bhopal	05/05/2020	04/05/2022	31.000

7	Development of Rapid Electrochemical based diagnostics for detection of SARS-COV-2 Infection	GAP0101	SERB-IRHPA	07/09/2020	06/09/2023	46.00240
8	Lab to field demonstration of the electricity free filter device for fluoride free drinking water	GAP0103	DST	10/11/2020	09/11/2023	62.62434
9	Fabrication of carbon nano-tube metal oxides based nano architecture as a flexible anode for lithium batteries	GAP0104	DST	13/01/2021	12/01/2024	18.49210
10	Development of Nanofibrous antimicrobial wound dressing for chronic wound infections and skin regeneration	GAP0105	SERB	03/02/2021	02/02/2023	30.83450
11	Conversion of CO_2 into useful fuel gases via novel nanoparticles dispersed N-doped graphitic carbon nano-fiber electrodes-based bio-electrochemical fuel cell	GAP0094	DST	08/05/2019	02/05/2022	13.53514

Sponsored Projects (SSP):

S.No	Title of the Project	Project Code	Sponsoring Agency	Start Date	End Date	Project Cost (Rs. Lakhs)
1	Utilization of bed ash and pet coke fly ash generated at Bharat Oman Refineries Limited, Bina (M.P.) for wider application spectrum	SSP 0055	Bharat Oman Refineries Limited, Binna, District Sagar, M.P.	19/11/2019	18/11/2021	23.40+GST

2	Investing the use of Silico-Manganese slag for application as mine stowing material	SSP 0057	Ramnik power & Alloys (P) Ltd., Balaghat M.P.	04/02/2021	03/05/2022	6.40+GST
3	Design, development and supply of Aluminium foam	SSP 0053	Ordinance Factory, Medak, Telangana	13/03/2019	31/03/2021	30.00

List of Completed Projects:
MLP/HCP Projects:

S. No	Title of the Project	Project Code	Name of Sponsor	Date of Start	Date of Completion	Project Cost (Rs. In lakhs)
1	Pilot implementation of CSIR Virtual Laboratory (for school students)	HCP0101	CSIR	1/12/2020	31/03/2021	38.000
2	Development of Solid-state electromagnetic joining technique for materials of interest in aerospace/space	MLP 0105	CSIR	22/07/2018	31/03/2020	96.90
3	Electromyogram (EMG) Controlled below Elbow prosthesis-"Light weight Shape Memory Alloy (SMA) wire actuated prosthetic hand	MLP 106	CSIR	02/08/2018	31/03/2020	55.000
4	Development of multilayer sandwich panal for defence applications	MLP 107	CSIR	18/08/2018	31/03/2020	155.000
5	Red mud based lead free material for X-Ray and CT Scanner rooms	MLP0108	CSIR	24/08/2018	23/08/2019	53.20
6	Design and development of bamboo structures (Bamboo/Composite sections & joints) (Joint project of CSIR-AMPRI, CSIR-IHBT, CSIR-CSIO and CSIR-CBRI)	MLP0109	CSIR	24/08/2018	31/03/2020	429.600

7	Centre for Morphological, Compositional and Structural analysis employing Eelctron Microscopy and Electron Electroscopy (FCP)	MLP0110	CSIR	28/08/2018	27/08/2019	850.000
8	Additive manufacturing of Graphene reinforced metal and polymer composites	MLP0111	CSIR	28/08/2018	31/03/2020	62.88
9	Hierarchial Reinforcement approach for improved ILSS of CFRP	MLP0112	CSIR	28/08/2018	31/03/2020	96.00
10	Advanced Geopolymeric coating material for structures of mild steel (AGCM)	MLP0113	CSIR	03/09/2018	02/03/2020	49.00
11	Up scaling of Advanced Solid form Geopolymeric Concrete for road applications	MLP0114	CSIR	03/09/2018	31/03/2021	287.00
12	Development and Manufacturing of hybrid green composites using industrial and agro wastes in pilot scale and facilitating entrepreneurship	MLP0115	CSIR	03/09/2018	31/03/2020	203.548
15	Electrical Insulating Hybrid Composite sheet using industrial inorganic wastes	MLP0116	CSIR	06/09/2018	31/03/2020	64.40
16	Development of metallic foam for biological, thermal and engineering application	MLP0117	CSIR	12/09/2018	31/03/2020	251.40
17	Prospects in development of Magnesium alloys for engineering and biological applications	MLP0118	CSIR	18/09/2018	31/03/2020	141.00
18	High performance metal matrix composites for transportation, defense, aerospace and engineering sectors	MLP0119	CSIR	20/09/2018	31/03/2020	245.72
19	Development of open cell aluminum foam for sink and EMI shielding applications	OLP0116	CSIR	04/12/2018	03/12/2020	9.00
20	Development of fly ash based geopolymeric materials for broad application spectrum	MLP0120	CSIR	01/12/2018	31/03/2020	110.60

21	Pilot scale production and demonstration of closed cell aluminium composite and hybrid composite foam for automobiles, rail, ship, buildings, defense and construction sectors	MLP0121	CSIR	17/12/2018	31/03/2020	166
22	Utilization of waste through appropriate technologies for developing value added products	MLP0122	CSIR	19/02/2019	31/03/2020	48.75
23	CSIR Integrated Skill Initiative	NWP 100	CSIR	12/03/2019	31/03/2020	168.50
24	Jigyasa-to inculcate scientific temper amongst school children	NWP 101	CSIR	12/03/2019	31/03/2020	49.10

Grant- in- Aid Projects

S. No	Title of the Project	Project Code	Name of Sponsor	Date of Start	Date of Completion	Project Cost (Rs. In lakhs)
1	Manufacturing light weight high strength and glossy finish polymeric composites from marble and granite waste stream	GAP0079	DST	15/12/2016	30/09/2020	315.26-DST 135-CSIR
2	Up Scaling of technology for making advanced non- toxic radiation Shielding materials of strategic importance, utilizing Industrial wastes	GAP 0081	DST AND CSIR	05/07/2016	27/12/2020	279.884-DST 279.84 CSIR Total 559.76
3	Development of multi-elementally and nano morphologically modified advanced light weight carbon nano tubes-based radiation shielding bandage useful for broad application spectrum	GAP 0085	DST	23/02/2017	22/02/2020	24.950
4	Fabrication of high-performance piezoelectric nano-generators	GAP 0086	DST	21/12/2017	07/10/2020	22.56858

5	Durable water repellent and stain resistant super hydrophobic textile finishes based on polymer nano-composite	GAP 0087	DST	18/04/2018	27/03/2021	26.514
6	Fabrication of high dense sintered Red Mud X ray and Gamma ray shielding applications	GAP 0088	MPCST	02/08/2018	31/03/2021	8.40
7	Development of metal pyrophosphate electrolytes for proton conducting ceramic electrolytes fuel cell operating in 100-400 C	GAP 0089	SERB	10/10/2018	30/06/2020	23.247
8	Tetravalent metal pyrophosphate-alkali carbonate composite electrolytes for fuel cells operating in intermediate temperature range	GAP 0090	SERB	26/11/2018	25/11/2020	58.536
9	Development of open cell aluminium foams for heat sink and EMI Shielding applications	GAP 0091	Min. of Mines	04/12/2018	15/04/2021	30 (21 Min. of Mines +9 CSIR AMPRI))
10	Development and fabrication of high-power energy and density su2percapacitor based on conjugated microporous Polymer	GAP0096	SERB, New Delhi	20/03/2020	19/03/2022	19.20
11	Graphene based composite for high performance thermally conducting interface and Electromagnetic Interface shielding applications	GAP0099	DST Inspire, Govt. of India, New Delhi	21/11/2019	09/05/2021	13.15205
12	Development and Demonstration of Hospital/Clinic/Housing technology for immediate preparedness in event of COVID-19 outbreak/post disaster rehabilitation	GAP0100	M.P. Council of Science and Technology, Bhopal	03/09/2020	02/03/2021	5.90

13	AICTE Training and Learning (ATAL) Faculty Development Program (FDP) online	GAP0102	AICTE	05/11/2020	31/12/2020	0.93000

Sponsored Projects:

S. No	Title of the Project	Project Code	Name of Sponsor	Date of Start	Date of Completion	Project Cost (Rs. in Lakhs)
1	Design, development and supply of Aluminium foam	SSP 0053	Ordinance Factory, Medak, Telangana	13/03/2019	31/03/2021	30.00
2	Techno Commercial study for production of value-added products from by production of 2G ethanol bio-Refinery, Bargarh, Odisha	SSP 0054	Bharat Petroleum Corporation Limited, Mumbai and IIP Dehradun	22/11/2019	21/09/2020	6.00
3	Water table depletion study in and around Sanjay Gandhi Thermal Power Station, Birsinghpur, Madhya Pradesh along with rain water harvesting to recharge water for the ground water enrichment	SSP 0056	Sanjay Gandhi Thermal Power Station, MP, Umaria	15/07/2020	14/07/2020	19.50

Consultancy Projects

S. No	Title of the Project	Project Code	Name of Sponsor	Date of Start	Date of Completion	Project Cost (Rs. in Lakhs)
1	Assessment of secured landfill site and its impact on surrounding region of Birla Cable Limited, Udyog Vihar, Rewa, M.P.	CNP 0114	Birla Cable Limited, Udyog Vihar, PO Chorhata, Rewa	19/11/2019	18/05/2020	5.0

Patents

Filed in India

S.No	Title	Inventors	Application No.
1	Hybrid composition comprising carbon nanotubes impregnated in nano sodium based gadolinium compound and the process for preparation thereof	Verma Sarika, Sanghi Sunil Kumar, Khan Mohammed Akram, Rathore Sanjai Kumar Singh, Srivastava Avanish Kumar	202011021350
2	High dense red mud shields for X and γ- rays attenuation	Thankaraj Salammal Shabi, Mishra Deepti, Sanghi Sunil Kumar, Agrawal Varsha, Paulose Rini, Arya Rahul, Sathaiah Sriram, Rathore S K S, Srivastava Avanish Kumar	202011039832
3	Advanced inorganic - organic geopolymeric corrosion protective coating material for mild steel	Mishra Deepti, Gupta Rainy, TomarAkshay Singh, Sanghi Sunil Kumar, ThankarajSalammalShabi, Khan Mohd. Akram, Singh Archana, Gowri V Sorna, Rathore S K S, Srivastava Avanish Kumar	202011041359
4	Advanced lead free radiation protection materials utilizing modified brine sludge composition and the process thereof	Verma sarika, mili medha, khan mohammed akram, sanghi sunil kumar, hashmi syed azhar rasheed, rathore sanjai kumar singh, srivastava avanish kumar	202011045583
5	Advanced hybrid sanitization equipment via ultra-violet radiations, its components and designing thereof	Verma sarika, mili medha, dhand chetna, mishra alka, khan raju, chaurasia jamana prasad, khan mohammed akram, hashmi syed azhar rasheed, rathore sanjai kumar singh, srivastava avanish kumar	202011045586

6	Development of Alcoholic surcrose-based Superplasticizer for Geo-polymeric concrete and its process thereof	Manish Mudgal, Anil Kumar, Ramesh Kumar Chouhan, Archana Singh, Avanish Kumar Srivastava	202111015507
7	Bamboo based composite material and process for preparation thereof.	Hashmi syed azhar rasheed, naik ajay, gowri v sorna, saxenasajeev, shiramdas murali, rathore sanjai kumar singh, srivastava avanish kumar	201911034398
8	Lead free red mud-based x-ray shielding tiles	ShabiThankarajSalammal, Sanghi Sunil Kumar, Deepti Mishra, Rini Paulose, Varsha Agrawal, Rahul Arya, Akshay Singh Tomar, Rathore S K S, Avanish Kumar Srivastava.	201911033448
9	A glossy finish sandwich composite and process for preparing the same"	Asokan Pappu, Manoj Kumar Gupta, Alka Mishra, Peters Edward, A. Kulshreshth, S K S Rathore, Avanish Kumar Srivastava	201811047389
11	A frugal innovation for preparation of flexible leather into non flexible hybrid leather nano composite for multifunctional applications	Asokan Pappu, Dhiraj Kumar Bharti, Manoj Kumar Gupta, Ravi Patidar, Sanjai Kumar Singh Rathore, Avanish Kumar Srivastava	0191NF2020
12	Radiation shielding red mud-based hybrid composite panels and process for preparing the same	Gupta Manoj Kumar, AsokanPappu, Rathore Sanjai Kumar Singh, Srivastava Avanish Kumar, Verma Teerth Raj, Parihar Anit	202011007069
13	High performance glossy finish green hybrid composites with variable density and an improved process for making thereof	AsokanPappu, Gupta Manoj Kumar, Mishra Alka, Peters Edward, Kulshreshth Ajay, Rathore Sanjai Kumar Singh, Srivastava Avanish Kumar	201811016873
14	Multi-functional hybrid composite material from bamboo and process for preparation of the same	Hashmi SAR, Verma Sarika, Mili Medha, Gorhe, Nikhil, Naik Ajay, RathoreSanjai Kumar Singh, SrivastavaAvanish Kumar	201911040180

Filed in Foreign Countries

SNo	Country	Title	Inventors	Application No.
1	US	Advanced multi-functional asbestos free thermal insulating material and the process for preparation thereof	Verma Sarika, Sanghi Kumar Sunil, Khan Mohammed Akram, Rathore Sanjai Kumar Singh, Srivastava Avanish Kumar	16/996572
2	ZA	High performance glossy finish green hybrid composites with variable density and an improved process for making thereof	AsokanPappu, Gupta Manoj Kumar, Mishra Alka, Peters Edward, Kulshreshth Ajay, Rathore Sanjai Kumar Singh, Srivastava Avanish Kumar	2020/06736
3	US	High performance glossy finish green hybrid composites with variable density and an improved process for making thereof	AsokanPappu, Gupta Manoj Kumar, Mishra Alka, Peters Edward, Kulshreshth Ajay, Rathore Sanjai Kumar Singh, Srivastava Avanish Kumar	17/052193
4	CA	High performance glossy finish green hybrid composites with variable density and an improved process for making thereof	AsokanPappu, Gupta Manoj Kumar, Mishra Alka, Peters Edward, Kulshreshth Ajay, Rathore Sanjai Kumar Singh, Srivastava Avanish Kumar	3099141
5	EP	High performance glossy finish green hybrid composites with variable density and an improved process for making thereof	AsokanPappu, Gupta Manoj Kumar, Mishra Alka, Peters Edward, Kulshreshth Ajay, Rathore Sanjai Kumar Singh, Srivastava Avanish Kumar	19795959.6
6	MY	High performance glossy finish green hybrid composites with variable density and an improved process for making thereof	AsokanPappu, Gupta Manoj Kumar, Mishra Alka, Peters Edward, Kulshreshth Ajay, Rathore Sanjai Kumar Singh, Srivastava Avanish Kumar	PI 2020005714
7	BR	High performance glossy finish green hybrid composites with variable density and an improved process for making thereof	AsokanPappu, Gupta Manoj Kumar, Mishra Alka, Peters Edward, Kulshreshth Ajay, Rathore Sanjai Kumar Singh, Srivastava Avanish Kumar	BR1120200224243

8	CN	High performance glossy finish green hybrid composites with variable density and an improved process for making thereof	AsokanPappu, Gupta Manoj Kumar, Mishra Alka, Peters Edward, Kulshreshth Ajay, Rathore Sanjai Kumar Singh, Srivastava Avanish Kumar	201980042471.X
9	WO	Radiation shielding red mud-based hybrid composite panels and process for preparing the same	Gupta Manoj Kumar, Asokan Pappu, Rathore Sanjai Kumar Singh, Srivastava Avanish Kumar, Vermateerth Raj, Pariharanit	PCT/IN2021/050150
10	WO	A glossy finish sandwich composite and process for preparing the same"	AsokanPappu, Manoj Kumar Gupta, Alka Mishra, Peters Edward, A. Kulshreshth, S K S Rathore, Avanish Kumar Srivastava	WO 2020/121319 A1
11	USA	A frugal innovation for preparation of flexible leather into non flexible hybrid leather nano composite for multifunctional applications	AsokanPappu, Dhiraj Kumar Bharti, Manoj Kumar Gupta, Ravi Patidar, Sanjai Kumar Singh Rathore, Avanish Kumar Srivastava	0191NF2020
12	US	A glossy finish sandwich composite and process for preparing the same"	AsokanPappu, Manoj Kumar Gupta, Alka Mishra, Peters Edward, A. Kulshreshth, S K S Rathore, Avanish Kumar Srivastava	US20220048226
13	USA	New advanced lignin-based binder composition utilizing natural polyphenolic resources and the seawater via microwave irradiation and the process thereof	S.A.R Hashmi, Sarika Verma, MedhaMili, Mohd. Akram Khan, Murali Shiramdas, Sanjeev Sasena,NikhilGohrae, Ajay Naik,S.K.S Rathore, A. K. Srivastava	February 2021
14	USA	Advanced lead-free radiation protection materials utilizing modified brine sludge composition and the process thereof	Sarika Verma, Medha Mili, Mohd. Akram Khan, S.K. Sanghi, S.A.R Hashmi,S.K.SRathore,A. K. Srivastava	0090NF2020

Granted in India

SNo	Title	Inventors	Patent No.
1	Synthesis of open cellular Titanium foams through powder metallurgy route using Acrawax particles as the space holder material	Gaurav Kumar Gupta, Mohit Sharma, Om Prakash Modi, Braj Kishore Prasad	339113
2	A facile and low temperature process for the preparation of Li4Mn5O12 nanorods	Indra Bhushan Singh, Archana Singh, Satyabrata Das	345587
3	A novel process for making advanced tailored hybrid material (athm) utilizing glass fiber reinforced plastic waste and geopolymeric matrix, useful for broad application spectrum	Hashmi Syed Azhar Rasheed, Amritphale Sudhir Sitaram, Khan Mohammed Akram, Verma Sarika, Das Satyabrata	363285

Knowhow Transfer

S.No.	Name of Knowhow	Name of Party	Date of Agreement
1	AMPRICARE - Sanitizer and Face Mask	M/s MW Social Enterprise Private Limited, 383, B Block Silicon City, A.B. Road, Indore, M.P. -452001	11/05/2020
2	Makeshift Buildings for Hospitals, Housing and other purposes	M/s Janta Tent & Events, Shop No. 1, Hotel Lake View Ashok Lobby, Shyamla Hills, Bhopal-462013	29/06/2020
3	Evergreen hybrid composite of Parali-Agro waste and industrial waste	M/s Shubh Green Sheet Private Limited, Near Raj Electicals, Laxmipara, Jamul, Bhilai, Durg, Chhatisgarh-490024	16/10/2020
4	Nanoadsorbent-Nano biocides based membrane filter for the removal of arsenic, fluoride, micro-organisms etc of drinking water	M/s IBS Water Nano Purifier LLP, Bhopal, M-252 Arvind Vihar, Bagmugalia, Bhopal-462043	01/01/2021
5	AMPRICARE-Disinfectant Box (UV Rays Hybrid Technology)	M/s Apt Medical System Pvt. Ltd., Office no. 24&25, Yugay Mangal, Kothrud, Pune-411038	28/02/2021

MoU and NDA with Academic/R&D Institutions

S.No.	Name of Organization	Date
1	Toshniwal Brothers (SR) Private Limited Inc, 11, AECS Layout, 4th Main, 3rd Cross Sanjaynagar, 1st Stage, Bangalore-560094 (NDA) (for one year 04-082020 to 03/08/2021)	04/08/2020
2	Rabindranath Tagore University (RNTU), ChiklodhRaod, Bhopal (For three years)	26/09/2020
3	Peoples University, Bhanpur Bypass Road, Bhopal-462037 M.P. (For 10 Years)	25/11/2020
4	Titan Company Limited, 3 SIPCOT Industrial Complex, Hosur-635126/ Corporate office Integrity#193, Veerasandra, Electronics City P.O., Off Hosur Main Road, Bangalore 560100 (for six months) (NDA)	31/12/2020
5	Tripura State Council for Science and Technology, Agartala, Tripura-799006 (For Five Years)	02/03/2021

Research Publications

S. No.	Authors	Title	Journal	Vol	Page	Year	IF
1.	H. Bajpai, M. Mili, S.A.R Hashmi, A. K. Srivastava, A. Tilwari, M. Mohapatra, S. Verma	Synthesis and Characterization of Advanced Hybrid Titanium Compounds/ F-MWCNTs Nano Composites and their Antibacterial Activities	Journal of Sol-Gel Science & Technology	96	153	2020	2.606
2.	C. M. Leung, C. Dhand, V. Mayandi, R. Ramalingam, F. P. Lim, A. B. Veluchamy, N. Dwivedi, G. Orive, R. W. Beuerman, S. Ramakrishna, Y. C. Toh, X. J. Loh, N. K. Varma, A. W. C. Chua, R. Lakshminarayanan	Wound Healing Properties of Magnesium Mineralized Antimicrobial Nanofibre Dressings Containing Chondroitin Sulphate–A Comparison Between Blend and Core-Shell Nanofibres	Biomaterials Science	8	3454	2020	7.59
3.	V. K. Patle, R. Kumar, A. Sharma, N. Dwivedi, D. Muchhala, A. Chaudhary, Y. Mehta, D. P. Mondal, A. K. Srivastava	Three-dimension phenolic resin derived carbon-CNTs hybrid foam for fire retardant and effective electromagnetic interference shielding	Composites Part C: Open Access	2	100020	2020	N/A
4.	H. Jain, D. P. Mondal, G. Gupta, A. Kothari, R. Kumar, A. Pandey, S. Shiva, P. Agarwal	Microstructure and high temperature compressive deformation in lightweight open cell titanium foam	Manufacturing Letters	27	67	2021	N/A
5.	S. Singh, A. Pophali, R. A. Omar, R. Kumar, P. Kumar, D. P. Mondal, D Pant, N. Verma	A nickel oxide-decorated in situ grown 3-D graphitic forest engrained carbon foam electrode for microbial fuel cells	Chemical Communications	57	879	2021	6.065
6.	P. Singh, V. Shrivastava, A. Abhash, B. N. Yadav, I. B. Singh, D. P. Mondal, A. K. Srivastava	Compressive deformation and corrosion behaviour of moderate to highly porous Ti4Al4Co (wt%) alloy foam	Materials Chemistry and Physics	257	123718	2021	4.778
7.	A. Sharma, R. Kumar, V. K. Patle, R. Dhawan, A. Abhash, N. Dwivedi, D. P. Mondal,	Phenol formaldehyde resin derived carbon-MCMB composite foams for electromagnetic interference shielding and thermal management applications	Composites Communications	22,	100433	2020	7.685

8.	A. Srivastava, M. Singh, K. Karsauliya, D. P. Mondal, P. Khare, S. Singh, S. P. Singh	Effective elimination of endocrine disrupting bisphenol A and S from drinking water using phenolic resin-based activated carbon fiber: Adsorption, thermodynamic and kinetic studies	Environmental Nanotechnology, Monitoring & Management	14,	100316	2020	N/A
9.	B. N. Yadav, D. Muchhala, A. Abhash, P. Singh, R. Kumar, D. P. Mondal	Fabrication of ultra-light LM13 alloy hybrid foam reinforced by MWCNTs and SiCthrough stir casting technique	Materials Letters	279	128271	2020	3.574
10.	H. Jain, D. P. Mondal, G. Gupta, R. Kumar, S. Singh	Synthesis and characterization of 316L stainless steel foam madethrough two different removal process of space holder method	Manufacturing Letters	26	33-36	2020	N/A
11	Manoj G, C. Nithya, N Sathish, S. Kumar, N. Singh, Nitya B, A.K. Srivastava, S.Kumar	Electrochemical studies of crystalline CuS as an electrode material for non-aqueous Na-ion capacitor	New Journal of Chemistry	45	5272	2021	3.925
12.	S. Kumari, R. Kumar, P. R. Agrawal, S. Prakash, D. P. Mondal, S. R. Dhakate	Fabrication of lightweight and porous silicon carbide foams as excellent microwave susceptor for heat generation	Materials Chemistry and Physics	253	123211	2020	4.778
13.	A. Badkul, S. Saxena, D. P. Mondal	A numerical solution to accurately predict deformation behaviour of metallic foam material up-to densification region for the possible use in composite structures	Composite Structures	246	112419	2020	6.603
14.	B. N. Yadav, D. Muchhala, S. Sriram, D. P. Mondal	Study on activation energy and strain rate sensitivity of closed-cell aluminium hybrid composite foam	Journal of Alloys and Compounds	832	154860	2020	6.371
15.	P. Bakshi, A. Pappu, R. Patidar, M. K. Gupta, V. K. Thakur	Transforming Marble Waste into High Performance, Water Resistant and Thermally Insulative Hybrid Polymer Composites for Environmental Sustainability	Polymers	12 (8)	1781	2020	4.967

16.	V. Chilla, D. P. Mondal, G. D. J. Ram, M. Mukherjee	Thermal Expandometer: A Device for Monitoring In-situ Foam Filling of Hollow Profiles Processed Through Powder Metallurgy	Transactions of the Indian Institute of Metals	73	1837	2020	1.391
17.	R. Kumar, A. Sharma, A. Pandey, A. Chaudhary, N. Dwivedi, D. P. Mondal, A. K. Srivastava	Lightweight carbon-red mud hybrid foam toward fire-resistant and efficient shield against electromagnetic interference	Scientific Reports	10	9913	2020	4.996
18.	K. S Verma, D. Muchhala, S. Panthi, D. P.Mondal	Experimental and Numerical Study of Compressive Deformation Behavior of Closed-Cell Aluminum Foam	Strength of Materials	52	451	2020	0.667
19.	A. Abhash, P. Singh, R. Kumar, S. Pandey, S. Sathaiah, M. M. Shafeeq, D. P. Mondal	Effect of Al addition and space holder content on microstructure and mechanical properties of Ti2Co alloys foams for bone scaffold application	Materials Science and Engineering: C	109	110600	2020	7.328
20.	D. D. Majumdar, V. Kumar, A. Roychowdhury, D. P. Mondal, M. Ghosh, S. K. Nandi	In vivo analysis of bone-tissue interface in medical grade titanium and porous titanium with and without cenosphere as space holder	Materialia	9	100623	2020	-
21.	P. Ranjan, A. Parihar, N. Kumar, C. Dhand, S. Murali, D. Mishra, S. K. Sanghi, J. P. Chaurasia, A. K. Srivastava, R. Khan	Biosensor-based diagnostic approaches for various cellular biomarkers of breast cancer: A comprehensive review	Analytical Biochemistry	610	113996	2020	3.191
22.	A.K. Srivastava, N. Dwivedi, C. Dhand, R. Khan, N. Sathish, M. K. Gupta, R. Kumar, S. Kumar	Potential of Graphene-based Materials to Combat COVID-19: Properties, Perspectives and Prospects	Materials Today Chemistry	18	100385	2020	7.613
23.	A. Parihar, P. Ranjan, S. K. Sanghi, A. K. Srivastava, Raju Khan	Point-of-Care Biosensor-Based Diagnosis of COVID-19 Holds Promise to Combat Current and Future Pandemics	ACS Applied Bio Materials	2	7326	2020	N/A

24.	N. Dwivedi, C. Dhand, E. C. Anderson, R. Kumar, B. Liao, R. J. Yeo, R. Khan, J. D. Carey,M. S. M. Saifullah, S. Kumar,H. K. Malik,S. A. R. Hashmi,A.K. Srivastava,S. K. R. S. Sankaranarayanan,R. Stangl,S. Duttagupta	Solution Processable High Performance Multiwall Carbon Nanotube–Si Heterojunctions	Advanced Electronic Materials	6	2000617	2020	7.633
25.	A. K. Srivastava, J. Prasad Chaurasia, R. Khan, C. Dhand, S. Verma	Role of Medicinal Plants of Traditional Use in Recuperating Devastating COVID-19 Situation	Medicinal & Aromatic Plants	9	359	2020	N/A
26.	V. S. Gowri, R. K. Sen, S. K. Sanghi, A. K. Srivastava	New Epoxy Poly(dimethyl acrylamide) Polymer for the Dispersion of ZnO Nanoparticles	Advanced Science, Engineering and Medicine	12	1231	2020	N/A
27.	D. Qureshi, K. P. Behera, D. Mohanty, S. K. Mahapatra, S. Verma, P. Sukyai, I. Banerjee, S. K. Pal,B. Mohanty, D. Kim, K. Pal	Synthesis of novel poly (vinyl alcohol)/tamarind gum/bentonite-based composite films for drug delivery applications	Colloids and Surfaces A:Physicochemical and Engineering Aspects	613	126043	2020	5.518
28.	K. S. Verma, S. K. Panthi, D. P. Mondal	Compressive deformation behavior of closed cell LM-13 aluminum alloy foam using finite element analysis	Materials Today: Proceedings	28	1073	2020	N/A
29.	C. Dhand, C. M. Leung,V. Mayandi,R. Ramalingam, F. P. Lim,A. B. Veluchamy, N. Dwivedi, G. Orive, R. W. Beuerman, S. Ramakrishna, Y. Toh, X. J. Loh, N. K. Verma, A. Chua, R. Lakshminarayanan	Wound Healing Properties of Magnesium Mineralized Antimicrobial Nanofibre Dressings Containing Chondroitin Sulphate–A ComparisonBetween Blend and Core-Shell Nanofibres	Biomaterials Science	8	3454	2020	7.59

30.	S. Ahirwar,M. Subzar Malik, R. Ahirwar, J. P. Shukla	Identification of suitable sites and structures for artificial groundwater recharge for sustainable groundwater resource development and management	Groundwater for Sustainable Development	11	100388	2020	5.9
31.	M. Mudgal, S. Kushwah,R. K. Chouhan, A. K. Srivastava	Enhancing reactivity and properties of fly-ash-based solid-form geopolymer via ball-milling	Emerging Materials Research	9	2	2020	1.795
32.	A. Mandal, J. K. Tiwari, B. AlMangour, N. Sathish, S. Kumar, M. Kamaraj, M. Ashiq, A. K. Srivastava	Tribological behavior of graphene-reinforced 316L stainless-steel composite prepared via selective laser melting	Tribology International	151	106525	2020	5.62
33.	R. Chaturvedi, R. K. Gupta, N. R. Gorhe, P. Tyagi	Percolative polyurethane-polypyrrole-straw composites with enhanced dielectric constant and mechanical strength	Composites Part A: Applied Science and Manufacturing	131	105810	2020	9.463
34.	S. S. Tripaliya, M. K. Gupta, R. Sahu, A. Pappu, C. Sharma, A. K.Chaturvedi, A. K. Srivastava	Tuning surface resistivity and thermal conductivity of water resistant fly ash waste based polymer composite via tailoring the interfacial polarization	Journal of Metallurgy and Materials Science	62	71	2020	10.319
35.	D. K. Bharti, S. Badatya, P. Tanwar, J. Tawale, A. K. Srivastava, M. K. Gupta	Observation of anomalous phase transition and band gap shrinkage in zinc germanatenanorods	Materials Science and Engineering: B	259	114602	2020	3.407
36.	D. K. Bharti, M. K. Gupta, R. Kumar, N. Sathish, A. K. Srivastava	Non-centrosymmetric zinc silicate-graphene based transparent flexible piezoelectric nanogenerator	Nano Energy	73	104821	2020	19.07
37.	N. Prasanth, M. Sharma, R. N. Yadav, P. Jain	Designing of latent heat thermal energy storage systems using metal porous structures for storing solar energy	Journal of Energy Storage	32	101990	2020	8.907

38.	S. Kumar, M. Ahmed, S. K. Panthi	Investigation on the crack and thinning behaviour of Aluminium alloy 5052 sheet in stretch flanging process	Journal of Failure Analysis and Prevention	20	1212	2020	N/A
39.	A. Shrivastava, A. Telang, A.K. Jha, M. Ahmed	Effect of Thickness and Energy on Electromagnetic Compression of AA6061 Tube	Journal of the Brazilian Society of Mechanical Sciences and Engineering	42	372	2020	2.361
40.	S. Malvi, R.K.Chouhan, M. Mudgal, R. Joshi	Economical aspects of Fly Ash Based Geopolymer Concrete Paver Block	International Journal of Emerging Trends in Engineering and Development	4	16	2020	N/A
41.	P. Tyagi, R. Chaturvedi, N. R. Gorhe,	Macroporous poly(vinyl chloride)-polypyrrole composites with piezoresistive behaviour,	Materials Letters	280	128566	2020	3.574
42.	H. Jain, D. P. Mondal, G. Gupta, R. Kumar	Effect of compressive strain rate on the deformation behaviour of austenitic stainless steel foam produced by space holder technique	Materials Chemistry and Physics	259	124010	2021	4.778
43.	M. Mohbe, D. P. Mondal	Properties of Zn foam filled with cenosphere microballoons	Materials Today: Proceedings	46	7448	2021	N/A
44.	S. Verma, M. Mili, H. Bajpai, S. A. R. Hashmi, A. K. Srivastava	Advanced Lead Free, Multi-Constituent Based Composite Materials for Shielding Against Diagnostic X-Rays	Plastics, Rubber and Composites: Macromolecular Engineering,	50	48-60	2021	N/A
45	M. Singh, S. Singh, S. P. Singh and S. S. Patel.	Recent advancement of carbon nanomaterials engrained molecular imprinted polymer for environmental matrix.	Trends in Environmental Analytical Chemistry	27	e00092	2020	13.662

46.	P. Singh, V. Shrivastava, S. K. Srivastava, I. B. Singh, P. Agarwal, D. P. Mondal	Microstructural evolution, compressive deformation and corrosion behaviour of thermally oxidized porous Ti4Al4Co alloy made of mechanically alloyed powder	Materials Chemistry and Physics	261	124191	2021	4.778
47.	S. Yadav, M. A.Sadique, P. Ranjan, N. Kumar, A. Singhal, A. K. Srivastava, R. Khan	SERS-Based Lateral Flow Immunoassay for Point-of-Care Detection of SARS-CoV-2 in Clinical Samples	ACS Applied Bio Materials	4	2974	2021	N/A
48.	P. Prabhakar, R. K. Sen, N. Dwivedi, R. Khan, P. R. Solanki, A. K. Srivastava,C. Dhand	3D-Printed Microfluidics and Potential Biomedical Applications	Frontiers in Nanotechnology	3	1-16	2021	N/A
49	A. Pophali, S. Singh, N. Verma.	Simultaneous hydrogen generation and COD reduction in a photoanode-based microbial electrolysis cell.,	International Journal of Hydrogen Energy	45	25985	2020	7.139
50	S.Singh, L. Feng, J. Yin, SH. Lee, D. Kim	Significance of modification of slurry infiltration process for the precursor impregnation and pyrolysis process of SiCf/SiC composites.	Journal of the European Ceramic Society	40	2245	2020	6.364
51	A. Srivastava, M. Singh, K. Karsauliya, P. Khare, S. Singh, and S. P. Singh	An investigation towards effective elimination of endocrine disrupting bisphenol A and S from real samples using highly porous activated carbon fibers.	Environmental Nanotechnology, Monitoring and Management	14	100316	2020	N/A
52.	N. Dwivedi, C. Dhand, D. C. J, E. C. Anderson, R. Kumar, A. K. Srivastava, H. K. Malik, M. S. M. Saifullah, S. Kumar, R. Lakshminarayanan, S. Ramakrishna, C. S. Bhatia, A. Danner	The rise of carbon materials for field emission	Journal of Materials Chemistry C	9	2620-2659	2021	8.067

53.	N. Dwivedi, C. Dhand, R. Kumar, K. Lodhi, J. Vishwakarma, R. K. Gupta, P. Kumar, S. A. R. Hashmi, S. Mishra, H. K. Malik, S. Kumar, A. K. Srivastava	Observation of Anomalous Behaviour in Nitrogen Incorporated Hydrogenated Carbon Thin Films	Materials Chemistry and Physics	262	124316	2021	4.778
54.	B. Liao, N. Dwivedi, Q. Wang, R. J. Yeo, A. G. Aberle, C. S. Bhatia, A. Danner	A Comprehensive Fundamental Understanding of Atomic Layer Deposited Titanium Oxide Films for c-Si Solar Cell Applications	IEEE Journal of Photovoltaics	11	319	2021	4.401
55	S. Singh, M. Noori, N. Verma.	Efficient bio-electroreduction of CO2 to formate on a iron phthalocyanine-dispersed CDC in microbial electrolysis system.	Electrochemica Acta	338	135887	2020	7.336
56.	K. Kanwar, I. Coondoo, V. K. Malik, P. Kumar, S. Kumar, P. K. Kulriya, S. D. Kaushik, N. Panwar	A comparative study of the structural, optical, magnetic and magnetocaloric properties of $HoCrO_3$ and $HoCr_{0.85}Cr_{0.15}MnO_3$orthochromite	Ceramics International	47	7386	2021	5.532
57.	J. K. Tiwari, A. Mandal, N.Sathish, V. Yadav, K.G.Pradeep, A. K. Singh, A. K. Srivastava	Novel approach for micrographical investigation of graphene in additively manufactured graphene/AlSi10Mg composite	Materials Letters	284	128923	2021	3.574
58	K. Verma, D. K. Bharti, S. Badatya, A. K Srivastava and M. K. Gupta	A high performance flexible two dimensional vertically aligned ZnO nanodisc based piezoelectric nanogenerator via surface passivation.	Nanoscale Advances	2	2044	2020	5.598
59.	S. Singh, A. Pophali, R. A. Omar, R. Kumar, P. Kumar, D. P. Mondal, D. Pant, N. Verma	Nickel oxide-decorated in-situ grown 3-D graphitic forest engrained carbon foam electrode for microbial fuel cell	Chemical Communications	57	879	2021	6.065

60	R. Gupta, A. S.Tomar, D.Mishra, S. K. Sanghi	Multinuclear MAS NMR Characterization of Fly-Ash-Based Advanced Sodium Aluminosilicate Geopolymer: Exploring Solid-State Reactions, Chemistry select	Chemistry select	5	4920	2020	2.307
61.	P. K. Baghel, R. Kumar	Estimation of magnetorheological fluid constituent's concentration for efficient finishing process	Materials and Manufacturing Processes	36	626-635	2021	4.783
62	A. Pophali, S. Singh, N. Verma	A dual photoelectrode-based double-chambered microbial fuel cell applied for simultaneous COD and Cr(VI) reductions in wastewater	International Journal of Hydrogen Energy	46	3160	2021	7.139
63.	A. Singh, S. S. Bhadauria, M. Mudgal, S. S. Kushwaha	Engineering properties of geopolymer prepared by mild chemical activation of ground granulated blast furnace slag	Indian Journal of Engineering & Materials Sciences	27	996	2021	0.615
64.	P. Ranjan, A. Singhal, S. Yadav, N. Kumar, S. Murali, S. K. Sanghi, R. Khan	Rapid Diagnosis of SARS-CoV-2 using Potential Point-of-Care Electrochemical Immunosensor: Towards the Future Prospects	International Reviews of Immunology	40	126	2021	5.078
65.	Sheshadri, A. Krishna, S. Singh, B. A. Botre, H. N. Bhargaw, S. A. Akbar, P. Jangid, S. A. R. Hashmi	AI models for prediction of displacement and temperature in shape memory alloy (SMA) wire	In AIP Conference Proceedings	2335	050003	2021	N/A
66	M. K. Yadav, N. Panwar, S.Singh and P. Kumar,	Preheated self-aligned graphene oxide for enhanced room temperature hydrogen storage	International Journal of Hydrogen Energy	45	19561	2020	7.139

67	M. S. M. Saifullah, M. Asbahi, Maryam Binti-Kamran Kiyani, S. S Liow, S. B. Dolmanan, A. M. Yong, Esther A. H. Ong, A. Ibn Saifullah, Hui Ru Tan, N. Dwivedi, T. Dutta, R. Ganesan, S. Valiyaveettil, K. S. L. Chong, S. Tripathy	Room-Temperature Patterning of Nanoscale MoS_2 under an Electron Beam	ACS Applied Materials & Interfaces	12	16772	2020,	10.383
68	V. Mayandi, A. C. Wen C., C. Dhand, F.P. Lim, T.T. Aung, H. Sriram, N. Dwivedi, M. H. Periayah, S. Sridhar, M. H. U.T. Fazil, E. T. L. Goh, G. Orive, R. W. Beuerman, T. Barkham, X. J. Lohet al	Multifunctional Antimicrobial Nanofibre Dressings Containing ε-Polylysine for the Eradication of Bacterial Bioburden and Promotion of Wound Healing in Critically Colonized Wounds	ACS Applied Materials & Interfaces	12	15989	2020	10.383
69	Vikas, M. K. Yadav, P. Kumar and R. K. Verma	Detection of adulteration in pure honey utilizing Ag-graphene oxide coated fiber optic SPR probes	Food Chemistry December 2020	232	127346	2020	9.231
70	P Singh, P Agarwal, JP Shakya, DP Mondal	Effect of ball powder ratio on microstructure and compressive behaviour of porous Ti-4wt% Al alloy	IOP Conference Series: Materials Science and Engineering	1136	012065	2021	-

Paper in Rajbhasha

S. No.	Authors	Title	Journal	Vol	Page	Year	IF
1	Dwivedi, A. Pal, S. Singh Patel, J. P. Shukla	3D Printing Technology and its application in Construction	Sopan	-	5-11	2020	-

Book Chapter:

1. R. Kumar, A. Sharma, V. K. Patle, A. Pandey, N. Dwivedi, D. P. Mondal. Electromagnetic Interference Shielding in Phenolic Foam. In Phenolic Based Foams: Preparation, Characterization and Applications, edited by Prof. .Thomas Sabu, published by Springer Nature, 2021.
2. A. Pandey, R. Dubey, S. Kumar Srivastava, R. Saxena, G. K.Gupta, D.P. Mondal, R.Kumar. Mechanical Properties of Phenolic Foams. In Phenolic Based Foams: Preparation, Characterization and Applications, edited by Prof. Thomas Sabu, published by Springer Nature, 2021.
3. S. Mishra, D.P. Mondal, P.Kumar, , S. Singh (2021). Carbon Nanomaterials: A Prominent Emerging Materials Towards Environmental Pollution Study and Control. In: S.P.Singh, K. Rathinam, T. Gupta, A.K. Agarwal (eds) Nanomaterials and Nanocomposites for Environmental Remediation. Energy, Environment, and Sustainability. Springer, Singapore. https://doi.org/10.1007/978-981-16-3256-3_2
4. R. Keisham, S. Datta, S. Dutta, N. Jadon and **R. Khan,** Chapter, "Graphene-based nanostructures for biomedical applications", Book, 'Two Dimensional Nanostructures for Biomedical Technology' Elsevier, 2020, 101-135.https://doi.org/10.1016/B978-0-12-817650-4.00004-8
5. K. Behera, D Qureshi, B Mohanty, SK Habibullah, A Anis, H Shaikh, P Sarkar, S. Verma, K Pal ,Bentonite increases the corneal permeation of the drug from the tamarind gum hydrogels, Food, Medical, and Environmental Applications of Polysaccharides, 291-322,2021Elsevier

R & D Activities

Industrial Waste Utilization, Nano and Biomaterials

Development of Rapid Electrochemical based Diagnostics for Detection of SARS-CoV-2 Infection

Biosensors being rapid, cost effective, high throughput, easy to handle with capacity to miniaturize have potential to become mainstream diagnostic method. Apart from several advantages biosensors also provide high accuracy and sensitivity with limit of detection in fM range. Biosensors can detect biomarkers such as viral genome (RNA of SARS-CoV-2), viral antigens (spike, envelope and nucleocapsid proteins) and presence of antibodies which are specific for viral proteins in patients' sample.

The **Figure 1** depicts schematic which shows the main components of biosensors and the mode of signal generation. Recent studies revealed that biosensors hold good promise for fast, on the spot POC mass testing of SARS-CoV-2 infection in patients' sample which include nasopharyngeal swab, saliva, serum and blood plasma.

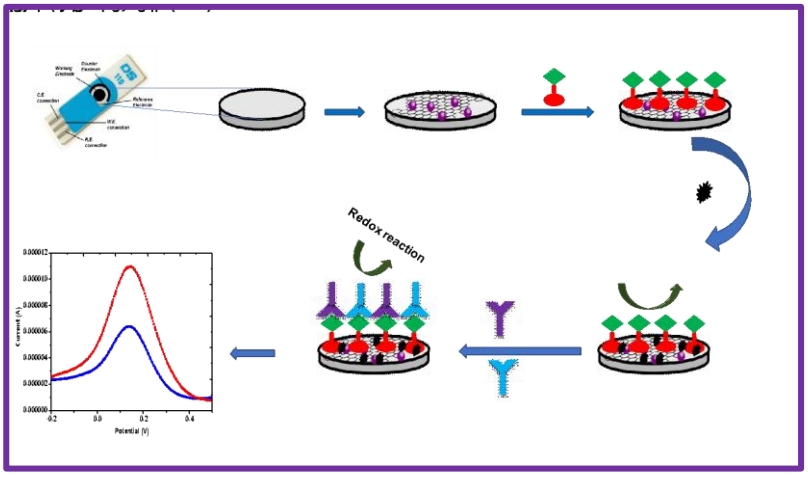


Figure 1

In the past year since the project has commenced, the continuous practice has been done at both theoretical understanding as well as experimentational front. The synthesis of graphene oxide (GO)

based nanocomposite has been successfully achieved and further confirmatory characteristics are being carried out. The electrochemical analysis of the synthesized GO-gold (Au) nanomaterials for their electrochemical performance and further developments to fabricate the immunosensor has been done at initial level. Some of the experimented work has been characterized and analysed for the development of the biosensor which are systematically presented in **Figure 2**. The promising results suggest the positive approach of the project which needs to be optimized with respect to the nanomaterial, incubation time, detection limit and viral load parameters. Further studies are being carried out to optimise the immunosensor and check the feasibility of the sensor in real patient samples as well. The biosensor diagnostic platforms rapidly detect viruses, which would replace thermal screening guns, currently screening for high fever in people coming through airports and border controls. This technology, which will be in the form of a hand-held device, to give results specific for this virus and can produce a result within few minutes. Our project proposal aim would help to design and develop highly sensitive, advanced rapid diagnosis of IgM-IgG combined or individual antibody test for SARS-CoV-2 infection which would pave the way for better and specific therapeutic outcome. Overall, our project is on electrochemical based biosensor devices which offers quick detection, accurate, portable and cost-effective tool for diagnosis of COVID-19.

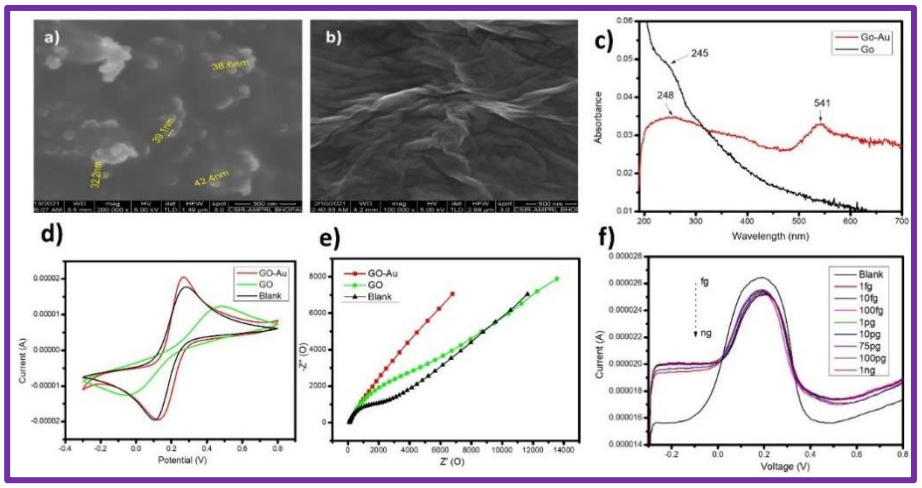


Figure 2

Application of Carbon Dots as Growth Enhancers in Agriculture System

The overall aims of this proposed project are intended to synthesis and develop the carbon dots-based photosynthesis enhancer for great potential in bioscience and biotechnology. The agro-technologies that have contributed for green revolution primarily concentrated on new high yielding crop varieties, fertilizers, water management technologies, crop protection techniques etc. The application and relevance of nanotechnology-based plant growth regulators or enhancers like carbon dots is not being explored for increasing agricultural production in a sustainable manner. Initial laboratory studies indicate that there is a huge potential for nanoparticles like carbon dots as plant growth regulators or enhancers through activation of photosynthesis. The carbon dots are known to induce fluorescence and activate photosynthesis in the plant system, which has a direct bearing on the agricultural production. In the present project activity, a systematic exploration is done with the application of carbon dots in the paddy crop in kharif 2020 cropping season. The crop has been raised in silt loam soils of Lucknow (Uttar Pradesh) under irrigated conditions. The effect of carbon dots on the on the crop physiology, photosynthesis and yield attributes along with the crop yield and biomass yield are measured. The project aims at study the efficacy of the mode of carbon dots application (induction) into the plant system vis-a-vis their effectiveness**. (Figure 3)**

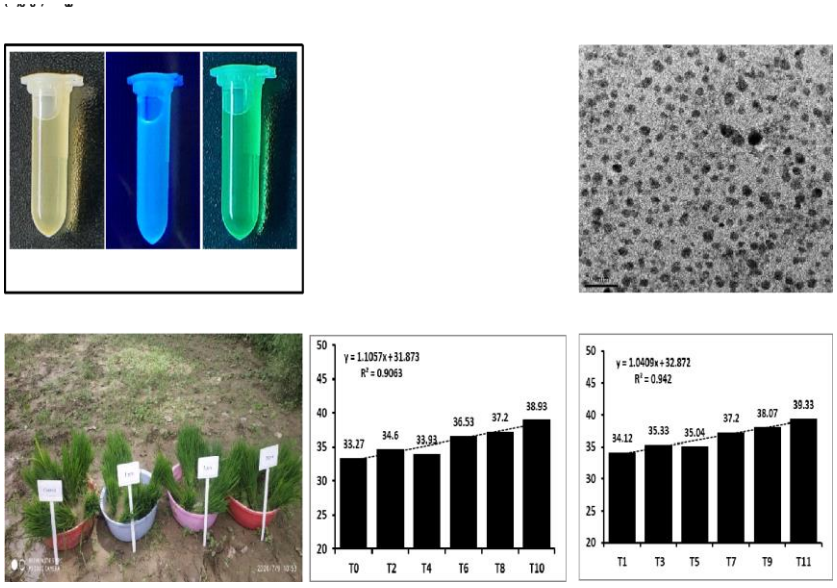


Figure 3

Fabrication of High Dense Sintered Red Mud Tiles for X and Gamma Ray Shielding Application.

Red mud is a solid hazardous alumina industrial waste, which contains 30-60% of hematite. The red mud was converted into diagnostic X-ray shielding tiles through ceramic route by adding a certain weight percentage of $BaSO_4$ and binders with it. The tiles fabricated using 45% red mud, 45% $BaSO_4$ and 10% clay shows better mechanical strength and X-ray attenuation characteristics. The kaolin clay tile has sufficient impact strength (failure point is 852 mm for 19 mm steel ball) and flexural strength of ~25 N/mm^2, which is suitable for wall applications. The 10.3 mm and 14.7 mm thick red mud: BaSO4: kaolin clay tile possess the attenuation equivalent to 2 mm and 2.3 mm lead at 125 kV and 140 kV, respectively. No heavy elements were found to leach out except chromium (Cr) and arsenic (As) from the sintered tiles. These tiles can be used in the X-ray diagnosis, CT scanner, bone densitometry, and cath labs instead of toxic lead sheets and thereby to protect the operating personnel, public, and environments from radiation hazards **(Figure 4).**

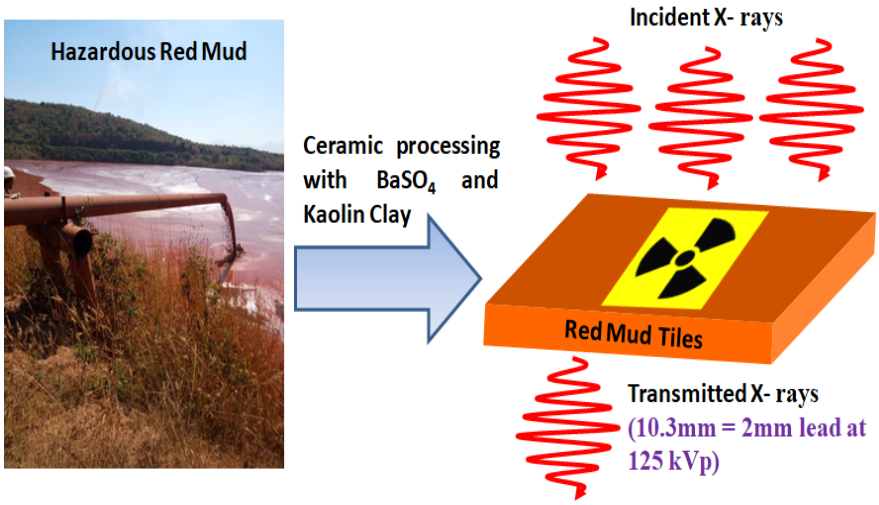


Figure 4

Conversion of CO_2 into useful fuel gases via novel nanoparticles dispersed N-doped graphitic nanofiber electrodes-based bio-electrochemical fuel cell

A facile and single-step nickel oxide-dispersed *in situ* grown 3-D graphitic forest engrained carbon foam (NiO-CNF-CF)-based electrode was fabricated for high-performance microbial fuel cells (MFCs). The metal oxide, graphitic contents, biocompatibility, stability and large surface area

available in the material for biofilm formation rendered the prepared electrode competent for wastewater treatment and bioenergy (0.79 V and 1.955 W m^{-2}) generation with a Coulombic efficiency of 85.66%. The electrode also proved to be stable for multiple-cycle MFC operation. The combined effects of NiO nanoparticles, graphitic CNFs, the porous structure of the material, and the electrical properties of carbon foam added up to a significantly superior MFC performance. The novel NiO-CNF-CF is a low-cost biocompatible electrocatalyst that can serve as a potential alternative to the existing**. (Figure 5)**

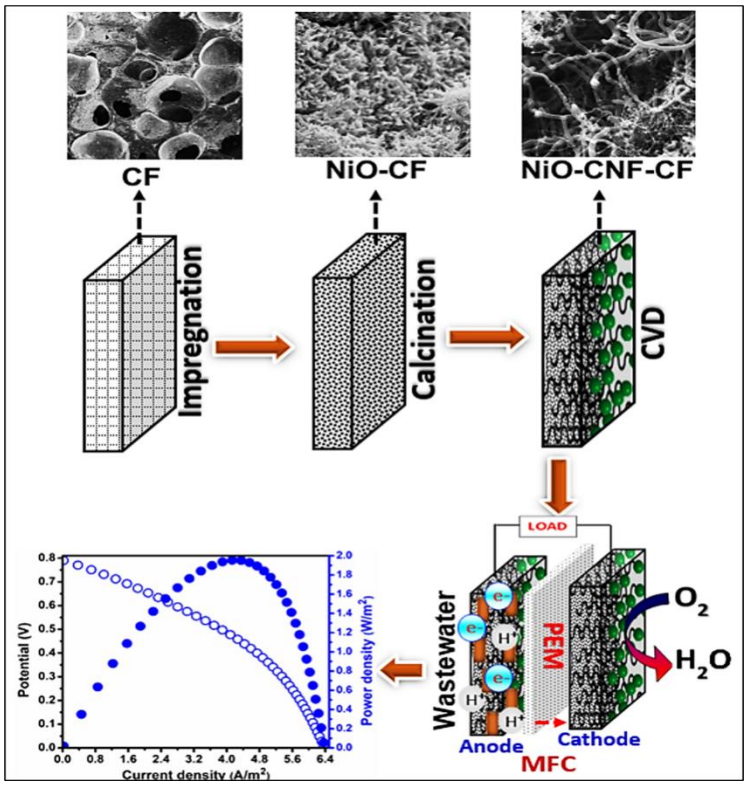


Figure 5

Cerium oxide (CeO2) and cuprous oxide (Cu2O) were used for the first time as photoanode and photocathode, respectively, in a microbial fuel cell (MFC) for simultaneous reductions of chemical oxygen demand (COD) and Cr(VI) in wastewater. The photoelectrodes were prepared by in situ dispersing the metal oxide nanoparticles in activated carbon fiber (ACF) and growing carbon nanofibers (CNFs) over the ACF substrate using catalytic chemical vapor deposition. The MFC, operated under light irradiation, showed approximately 94% COD and 97% Cr(VI) reductions. The MFC also generated a high bioelectricity with current density of ~6918 mA/m2 and power density of

~1107 mW/m2. The successful use of the developed MFC in this study was attributed to the metal oxides acting as an efficient photocatalyst, the graphitic CNFs, and the microporous ACF providing a large surface area for dispersion of the metal oxides. The MFC based on the inexpensive transition metal oxides-based photoelectrodes developed in this study has a potential to be used at a large scale for treating industrial aqueous effluents co-contaminated with organics and toxic Cr(VI).**(Figure 6)**

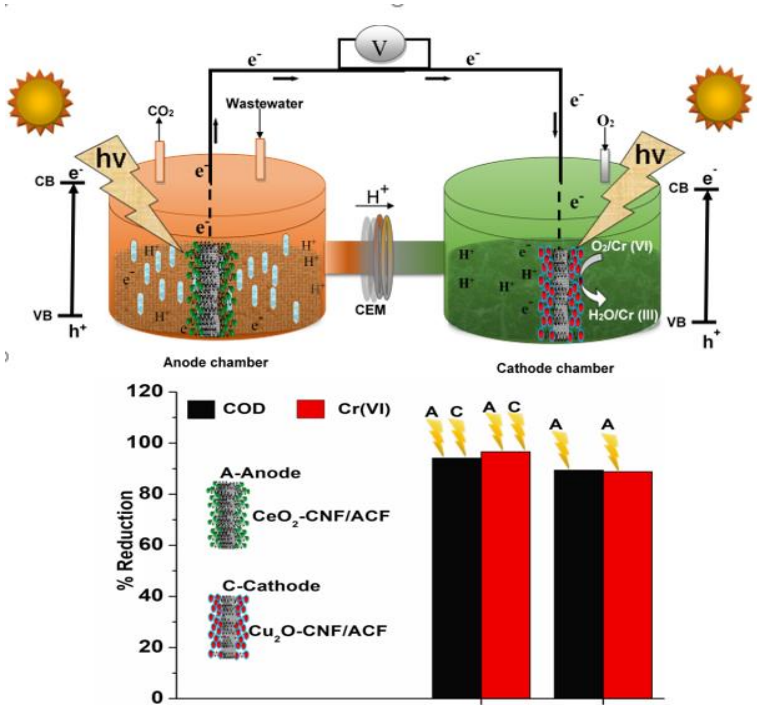


Figure 6

Development of special radiation shielding materials

(i) High density red mud blocks for industrial X- and γ-ray shielding:

The X-ray shielding tiles developed through the ceramic route suitable for shielding diagnostic X-rays until 140 kV. However, these tiles are not suitable for making radiation shielding structures for industrial radiography (≈300 kV), brachytherapy, radiotherapy bunkers (10-18 MeV), sterilisation plants, particle accelerators, radioactive nuclide storage rooms, nuclear power plants, etc. It requires quite thick walls like concrete to shield such high energy radiations due to its low density (2.4 g/cc) and high porosity (33%). So, we have recently developed ≈5g/cc gamma ray shielding blocks by hot compacting red mud with high Z additives **(Figure 7).** The density of the samples was found to increase twice as compared to the tiles fabricated through cold compaction and subsequent sintering.

Eventually the gamma ray attenuation characteristics of the samples were found to increase significantly **(Figure 8).** The half value layer (HVL) of the hot compacted red: Bi_2O_3 sample is 20.96 mm at 1.33 MeV. It possesses 60% attenuation of lead. Moreover, it has the compressive strength 282 MPa, which is suitable for building the radiation shielding structures without further structural support unlike lead.

Figure 7 High density red mud blocks for industrial x- and γ-ray shielding:

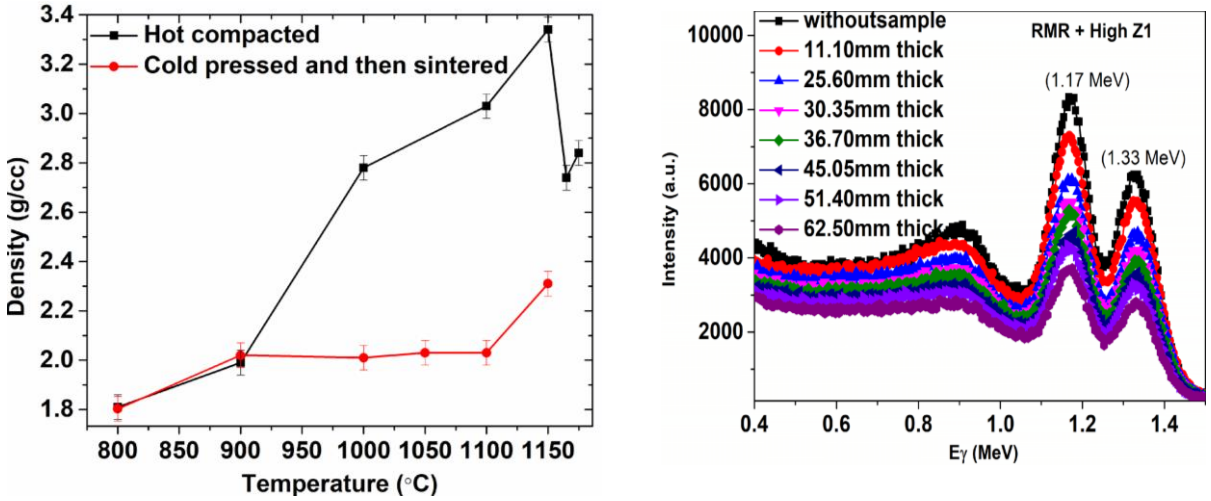


Figure 8: (Left) Depicts the role of compaction temperature on the density of the shield and (right) depicts the decrease in the intensity of the transmitted gamma ray while increasing the thickness of the shield.

(ii) Development of high-density radiation shielding glass for x-ray diagnostics

Developed two different compositions of glass using TeO_2 and Bi_2O_3 high density Te Oxides and Na_2O to Reduce Melting Temperature**.(Figure 9)**

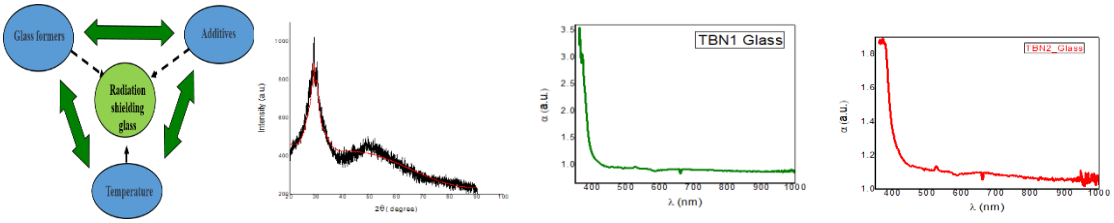


Figure 9

(iii) Design and development of advanced, cost-effective, EMI shielding material

- For development of EMI shielding material, red mud has been characterized by various sophisticated techniques.
- Mixture of red mud, carbon source and additives in appropriate combinations has been ball milled and then material has been developed in appropriate dimensions.
- Developed material has been then sintered at high temperature
- Developed material has been characterised by XRD to determine Magnetic and Electrical conducting phases. FTIR studies has been performed to determine organic and inorganic linkages present in the material. Morphology has been determined by SEM which indicated layered morphology and homogeneous matrix. **(Figure 10).**
- Optimization studies and Evaluation of EMI radiation shielding effectiveness of the developed samples to be carried out

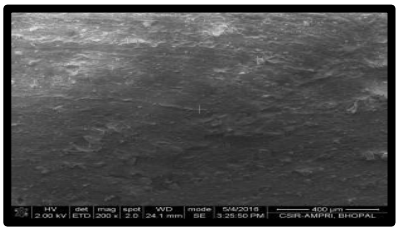


Figure 10

(iv) Flexible and mouldable material for x-ray, γ-rays and neutron shielding

- Developed Flexible and mouldable polymer composite material using varying percentage of WO_3 as filler (1-7.5 %) in PVA-PVP blend**.(Figure 11**)
- Density, tensile strength, X-ray attenuation characteristics, Half value layer and lead equivalent of developed material were determined for X-rays ranging from 60 kVp to 120 kVp. Samples were characterised by XRD, FTIR, SEM.
- Density of samples varied from 1.27 to 1.65 g/cc. Maximum density achieved: 1.65 g/cc.

- Sample with 5 % WO_3 loading showed highest X-ray attenuation coefficient of 0.54 mm-1 and HVL of 1.3 mm at 60 kVp. 9.9 mm (0.99 cm) thick sample posses the attenuation equivalent with 2 mm Lead at 60 kVp (mostly used for diagnostic imaging)
- Tensile strength was found to be 5.0 MPa.
- Shifting of frequency for O-H (stretching) at 3315.99 cm-1 in FTIR of PVA-PVP blend is observed between 3271.16 - 3277.64 in FTIR of developed polymer composite material using WO3 as filler (1-7.5 %). This may be due to formation of H-bonding between the hydroxyl functional group and the filler
- Functional groups other than hydroxyl group did not showed any significant shift in their stretching frequency
- XRD results confirmed the formation of crystals $Na_2W_2O_7$ and $Na_2WO_4.2H_2O$
- Development of flexible and mouldable polymer composites material using Bi, Ba, and B based compounds alone as well as in combination and evaluation of their radiation attenuation, mechanical properties and characterization are under progress.

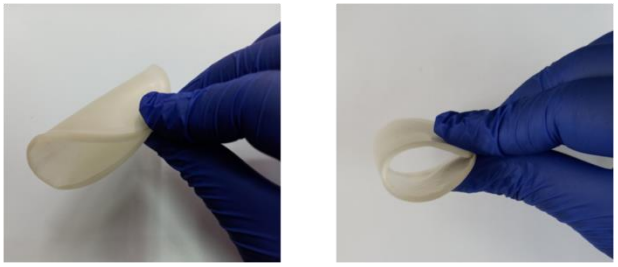


Figure 11 Developed Flexible and mouldable material

(v) Fabrics based on carbon nanotube finishing

- Development of light weight radiation shielding textiles using carbon nano tubes alternative to traditional toxic heavy metal (lead) based shielding fabrics is under progress.
- Multiwalled Carbon nanotubes were treated with different quantities of SDS(sodium dodecyl sulphate) to make them functional by incorporating OH, COOH groups in them.
- Textile was plasma oxidized to make it functional and coated with treated Carbon nanotubes.

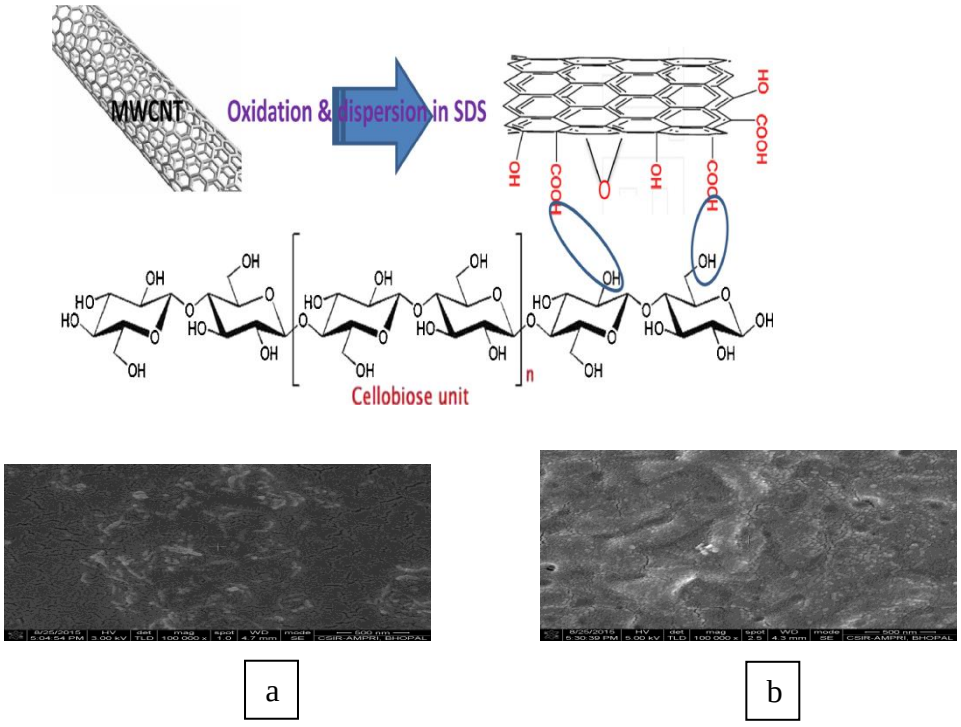
(Figure 12 and Figure 13)

Radiation attenuation characteristics were determined. PMMA/WO_3 Nanocomposite with optimized composition was found to attenuate 57.1% of a 50 kVp , 65% of a 70 kV and 67.46 of a 80 kVp X-ray beam. The respective linear attenuation coefficients (μ) were 2.249 cm^{-1} , 1.725 cm^{-1} and 1.58 cm-1, respectively. The results confirm that WO_3 /PMMA nanocomposites have enhanced the X-ray

shielding efficiency. Very thin, light-weight and high efficient X-ray Shielding fabrics can be manufactured, aiming patient skin protection applications in interventional radiology procedures.

- Morphological characterization of treated and untreated multiwalled carbon nanotubes as well as textile was done by SEM.
- Optimization of coating process, evaluation of attenuation property, interfacial bonding and mechanical properties of the treated fabric to be evaluated.

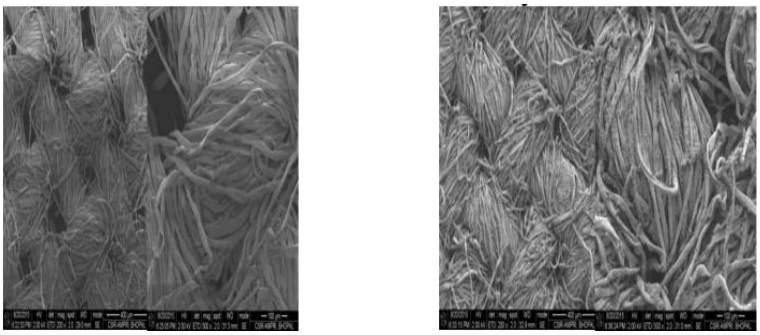
As seen from **Figure 12 (a),** the raw MWCNTs are in the form of agglomerated bundles and **Figure 12 (b),** Treatment of MWCNTs with surfactants shortens the length of the MWCNTs.



a b

Figure 12

Figure. 13 (a) shows the pores of cotton fabric without coating. The uncoated fabric features an interstices structure and **Figure.13 (b)** MWCNT coating effectively fills the pores and enwrap the walls of the pores in the fabric



a b

Figure 13

Development of polymer/ geopolymer based nanocomposites for antimicrobial coating applications

Geopolymeric precursor of different compositions were developed by together mechanochemical dry grinding of fly ash, alkali activators, other additives and TiO_2 (5-15 %) in a ball mill for a period of 8 hours and coating material was developed by adding water and organic additive to developed precursor material with continuous stirriring using mechanical stirrer . Developed precursor and coating material were characterized by XRD, FTIR and SEM. XRD of geopolymeric precursor with varying % of TiO2 (5-15 %) indicated presence of Quartz, syn (Silicon oxide), Mullite (Aluminium silicate), Hematite (Iron oxide), Sodium silicate, Sodium aluminium oxide, Sodium aluminium silicate, Sodium aluminium titanium oxide, Sillimanite (Aluminium silicon oxide), Aluminium titanium oxide, Sodium titanium oxide, Sodium titanium silicate, Anatase, syn (Titanium oxide) phases. XRD of geopolymeric coating material indicated presence of Sodium silicate hydrate, Sodium aluminium oxide hydrate, Herschelite (Sodium aluminium silicate hydrate), Sodium titanium oxide hydrate phases in addition to Quartz, syn (Silicon oxide), Mullite (Aluminium silicate), Hematite (Iron oxide), Sodium aluminium titanium oxide, Anatase, syn (Titanium oxide) phases already present in precursor material. Coating of developed material is done on mild steel substrate by spray coating technique. Interpretation of results of FTIR, SEM of precursor and coating material and evaluation of adhesion, scratch resistance, porosity, corrosion protection and antimicrobial properties of coating is under progress.

Development of Advanced Non - Toxic Radiation Shielding Material from Tailored Brine Sludge

The purpose of the work is the development of advanced non - toxic radiation shielding material from tailored brine sludge. Brine sludge is an industrial waste generated in chloral alkali industry. The brine sludge, was collected from Grasim Industries Ltd., Birlagram, Nagda - Dist. Ujjain (M.P.), India. The brine sludge was evaluated for its various properties like Chemical, Physical, thermal, mineralogy, Morphology using sophisticated techniques like IR, XRD, XRF, SEM, EDX, DSC etc.

The experimental trials and the detailed characterization for the development of advanced x-ray radiation shielding tiles is under progress and is followed by the Optimization of chemical compositions and processing parameters for the development of advanced non-toxic of the developed x-ray radiation shielding tile of desired dimensions**(Figure 14)**.

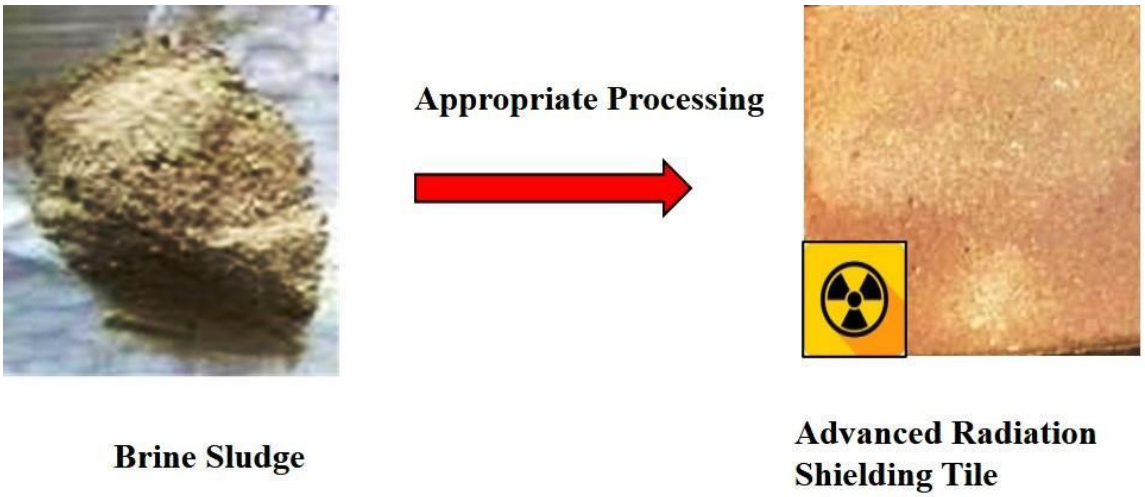


Figure 14 Assessment of Secured Landfill Site and its Impact on Surrounding Region of M/s Birla Cable Limited, UdyogVihar, Rewa (M.P.) (Project No. CNP-114)

The above project was awarded to CSIR-AMPRI, Bhopal by M/s Birla Cable Limited, UdyogVihar, Rewa (M.P.). The objective of the project was to assess the secured landfill (SLF) site and its Impact on surrounding region. Project envisaged collection of samples of SLF site and surrounding areas, ground water, water samples from piezometric points for testing & analysis purposes for preparation of report. The samples were analyzed for detailed physico-chemical characterization. The SLF site has been completely cleaned up of hazardous waste and HDPE Liners. **(Figure 15 and 16)**

Based on the study, it was recommended that the reclaimed land may be filled with soil or construction and demolition material and leveled off and used for plantation work, development of

green belt, construction work or any other project. Final project report has been submitted to the sponsoring agency.

Figure 15: Site visit and discussion held at Birla Cable Limited, Rewa (M.P.)

Figure 16: Team CSIR- AMPRI & Officials of Birla Cable Ltd. Rewa during Sample Collection at Site

Utilization of bed ash and pet coke fly ash generated at Bharat Oman Refineries Limited, Bina (M.P.) for wider application spectrum.

The above project was awarded to CSIR-AMPRI, Bhopal by M/s Bharat Oman Refineries Limited, Bina, District Sagar (M.P.). The objective of the study is to carry out detailed characterization of BORL fly ash and bed ash and examining the possibility of bed ash utilization in optimization along with fly ash for fly ash bricks and exploring different possibilities for broad application spectrum through geo-polymeric / other possible routes. In connection with the project work, a team of Scientists and Research Fellows from CSIR-AMPRI, Bhopal visited BORL Bina in the month of January 2021. The samples of Pet Coke Fly Ash (PCFA) and Bed Ash (BA) from fuel combustion ratio of Pet Coke: Coal (90:10) were collected from BORL, Bina for carrying out detailed physico-

chemical characterization including pH, moisture content, density, porosity, heavy metal analysis, mineralogical and morphological and to enable its suitability for development of geo-polymeric / other appropriate material include pavers, bricks and blocks, etc. as per characteristics of BORL fly ash and bed ash.

In this project, the physical and chemical properties of pet coke fly ash and bed ash were analyzed and possible utilization of bed ash blended with pet coke fly ash in different optimize ratios was investigated for development of brick. Further optimization of mix ratio of PCFA and BA in different fuel blends (100:0, 75:25) are in progress. A Project Review Meeting was also done with senior officials of BORL Bina on 6th October 2021 at BORL, Bina (M.P.) **Figure 17.**

Figure 17 Review Meeting with senior officials of BORL, Bina (M.P.) and Brick Sample using BORL PCFA and BA

Investigating the Use of Silico-Manganese Slag for Application as Mine Stowing Material.

The samples of silico-manganese slag were collected from Ramnik Power & Alloys Pvt. Ltd., Balaghat (M.P). The physico-chemical characterization including total metal analysis, mineralogical and morphological were analyzed to explore the possible application of silico-manganese slag as a filling material for stowing purpose in underground mines. (**Figure 18)** The project work is in progress.

Figure 18 Site visit & Discussion with Officials of Ramnik Power & Alloys Pvt. Ltd., Balaghat (M.P)

Synthesis of Zeolites from Flyash for Agriculture Applications

Production of zeolites is one of the potential applications of Coal Fly ash. Zeolites with its ability to exchange cations allow nutrients such as nitrogen, calcium, iron, magnesium, potassium and water to be available to the plant slowly and in a controlled manner when needed. Conversion of fly ash into zeolite is carried out using suitable single or two stage process. The synthetic material will be characterized with respect to microstructure, Chemical and mineralogical composition . Plant study like growth, yield, nutrient concentration and uptake etc will be carried out using suitable dosing of flyash zeolites with soil and the results will be compared with the control pot/plot. The study will indicate the scope of utilizing fly ash-based zeolites for nutrient holding capacity for better production.

Zeolites with its improved fertilizer efficiency will result in increased productivity and reduced nutrients leachability to the environment. The fertilizer market is both a high value and high-volume market. **(Figure 19)**

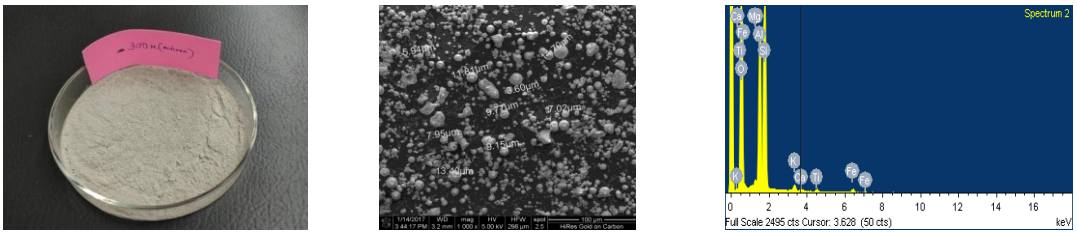


Figure 19

Electrochemical additive manufacturing process for sculptures, statues, and decorative arts applications

Additive Manufacturing (AM) refers to a process by which digital 3D design data is used to build up a component in layers by depositing material. Electrochemical Additive Manufacturing (ECAM) technique is one of the AM process by which metallic structures can be created using electrochemical reduction of metal ions in a solution onto a conductive substrate. A broad range of materials can be deposited in the ambient environment without any thermal damage and low-cost using the ECAM method. The plan of the research work is to synthesize metal nanoparticles using ECAM, process involved and showing applicability of these synthesized particles.

Here, firstly we have utilized electrochemical additive manufacturing (ECAM) process to fabricate stable copper electrode and their utilization in nitrate (NO_3^-) detection. The deposition process is shown in Figure 20. The deposited copper on ITO through the ECAM process reveals the growth of

crystalline Cu single-phase with FCC structure. The deposited copper electrode has a low electrical resistivity of ~3.9×10^{-5} Ω cm at room temperature. Additionally, the printed copper electrode exhibits a good response range from 5 µM − 2000 µM (R2 = 0.998), with high sensitivity (2.61 mA $\mu M^{-1}cm^{-2}$), low detection limit ~1.99 µM, and impressive anti-interference ability towards detection of nitrate.

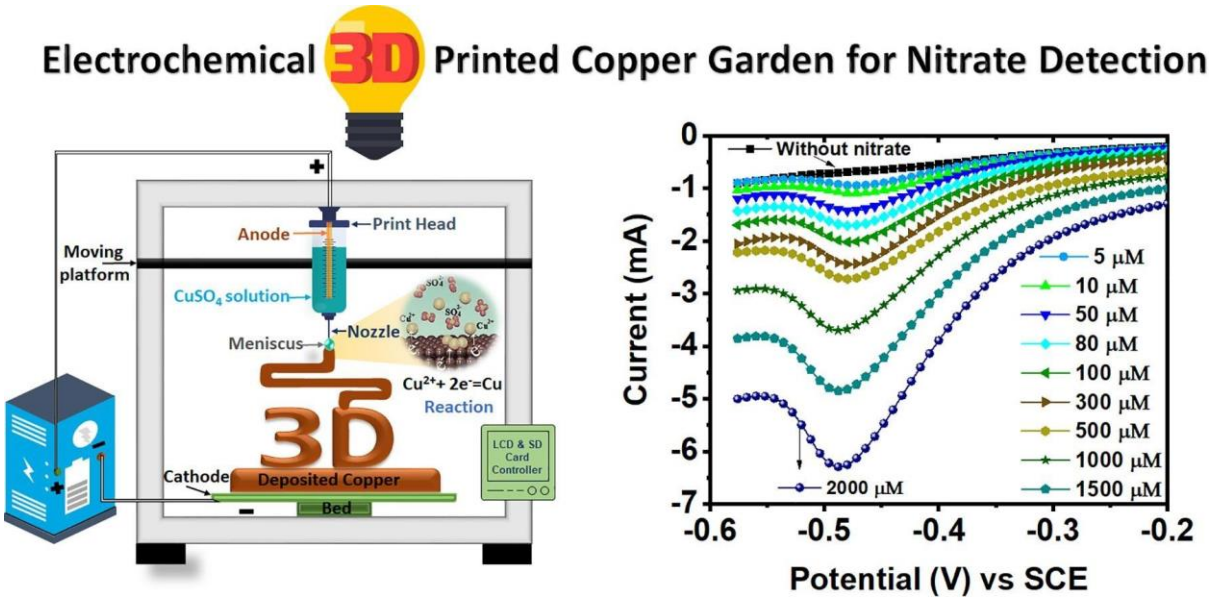


Figure 20: Electrochemical 3D printed copper garden for nitrate detection (HafsaSiddiqui, Netrapal Singh *et al.* Materials Letters, 305, 2021, 130795)

In another activity of the project, we have tried a quick detection of pharmaceutical drugs, such as paracetamol, pantoprazole sodium, and diclofenac sodium, by localized surface plasmon resonance (LSPR) Raman using novel meniscus confined electrochemical additive manufacturing (ECAM) printed silver nanoparticle substrate is studied. The ECAM printing process produced pure phase silver substrates without any impurity, and the quality of the electro-deposited substrates is analyzed by optical and scanning electron microscopy. The electro-deposited nanoparticle substrate has average crystallite and particle size 18 nm and 60 nm respectively. The LSPR Raman spectra show up to four times enhancement in the original Raman signals **(Figure-21**).

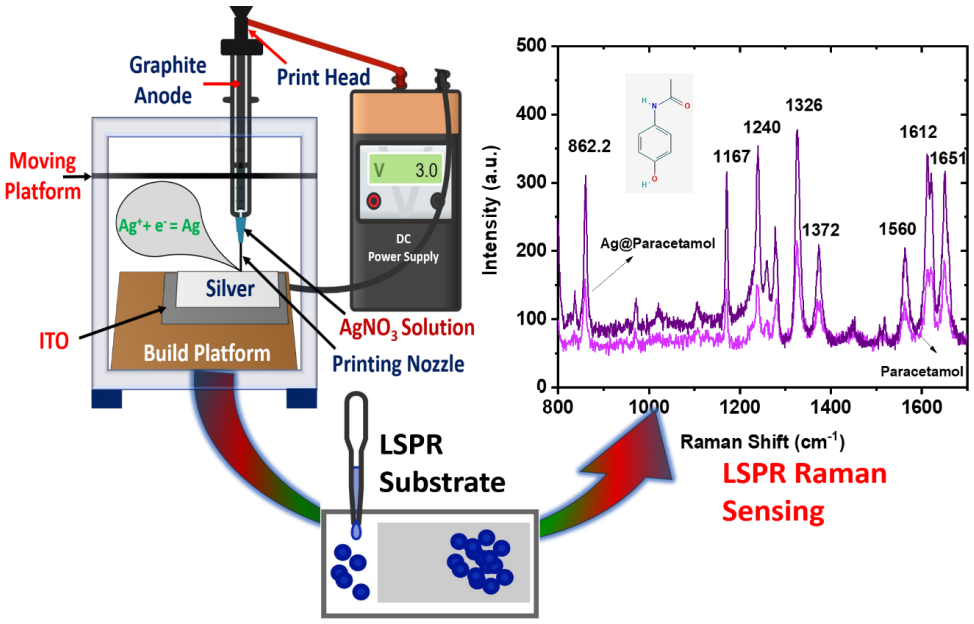


Figure 21: Electrochemical 3D Printed Substrate for Pharmaceutical Drugs Detection (Netrapal Singh, Hafsa Siddiqui *et al.* Materials Letters, 307, 2022, 130976)

Morphology controlled copper sulphide decorated with graphene sheets as an electrode material for Na-ion capacitor in aqueous and non-aqueous electrolytes

A hybrid ion capacitor (HIC) is a bridge between batteries and supercapacitors. Li-ion capacitors (LIC) pay attention to both academic and industrial research due to its high power density and high life cycle applications. It is based on reversible electrochemical energy storage which is the combination of secondary batteries and electrochemical capacitors. Due to limited reserves and the high cost of Li metal, it faces a big challenge for the large-scale manufacturing of LICs. Hence, there is a need to explore new candidate to replace Lithium for energy storage applications. Sodium (Na) was addopted as a substitute element because of its natural abundance and low price. It is produced from the land (salts, sodium carbonate, and NaOH) salts and water. The United States produced 44% of Na from mining and 38% from brine. Another advantage of Sodium is that its electronegativity (-2.714 V versus SHE) is very close to the electronegativity of Lithium (-3.04 V versus SHE). Nano-sized copper sulphide (CuS) is a most promising chalcogenide due to its unique properties. It is used for various applications like chemical sensors, Li-ion batteries, cathode materials and an optical filter.Copper sulphide has been considered the promising anode material in NIBs because of its high electrical conductivity (~10^3 Sm^{-1}) and specific capacity (~560 mAh g^{-1}). It provides a large surface area for sodium insertion and extraction. Copper sulphide had been explored as an anode material in

LIBs. Chen *et. al*,synthesized single-crystal copper sulphide thin film and used as anode material for LIBs. It is observed that this film has discharge capacity of 350 mAh g^{-1} and after 20 cycles the capacitance retention was found about 54.40%. Nanometre-sized morphologies of CuS can improve the cycle performance. For example, 10 nm copper sulphide rods were fabricated by Zhoo*et al*. they observed 561 mAh g^{-1} reversible capacity with good cycle stability after 250 cycles.In this project we have explored the various nanostructures of the copper sulphide (CuS) material as an electrode material for Na-ion capacitor.

The Nano crystalline CuS provides a large surface area for Na insertion / extraction. In this context, we are reporting CuS nanoparticle synthesis via a simple wet chemical route in which cupric acetate and sodium thiosulphate are used as precursor materials. XRD and FT-IR studies are carried out to determine the phase formation and confirmation of the purity of CuS nanopowder. The average crystal size (26 nm ±2) is calculated by the Scherrer equation which is well matching with the scanning electron microscopy (SEM) results. The surface area of 62 m^2g^{-1} is measured by BET surface area analyser**.**

NICs are assembled in non-aqueous medium with CuS nanoparticles and investigated for charge-cycling at 0.01 to 3 V current densities. Cyclic Voltammetry (CV) study confirms that at high scan rate of 10 mV s^{-1} to 100 mVs^{-1}, CuS nanoparticles show ideal capacitive behaviour. The calculated value of specific capacitance is 160 Fg^{-1} for the CuS nanoparticles. At 1 mVs^{-1} scan rate 74.8% capacitive contribution of CuS nanoparticles is obtained. The electrochemical Impedance Spectroscopy (EIS) study reveals interfacial interactions of CuS nanoparticleswith the Na-based electrolyte. **(Figure 22 and 23)**

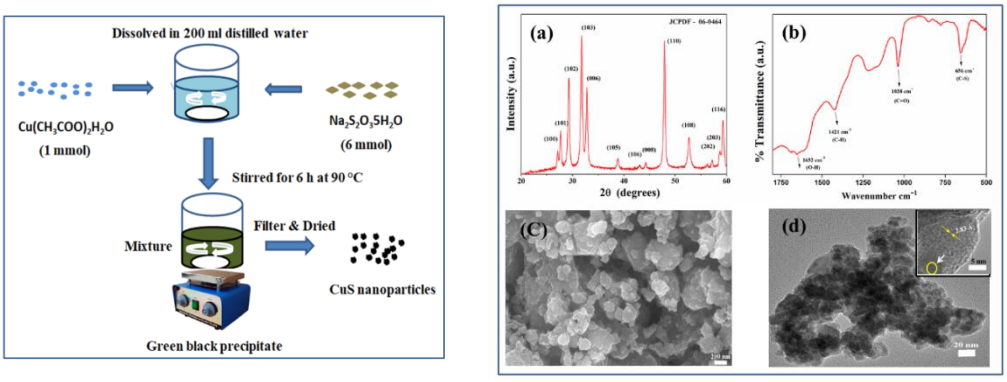


Figure 22 ***Schematic*****. General procedure for the synthesis of CuS nanoparticles. Figure. 22(a) Powder X-ray diffraction pattern, (b) FT-IR pattern, (c) FE-SEM image, (d) TEM image (in inset HR-TEM pattern) of synthesized CuS nanopowder.**

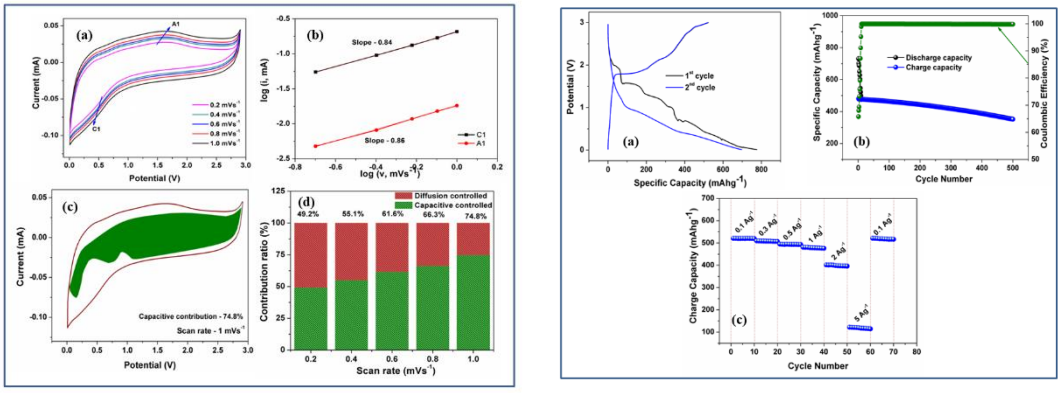


Figure 23. Electrochemical study of CuS nanoparticles in non-aqueous system.

Electrochemical studies are performed in an aqueous medium for each of the two and three-electrode systems. The specific capacitance of 87 and 13 Fg-1 are obtained at 0.5 Ag-1 for the symmetric and asymmetric device, respectively. For asymmetric devices, an energy density of 2.6 Wh/Kg (maximum) at a power density of 246 W/Kg is obtained and reduced to 1 Wh/Kg at the highest power density of 2980 W/Kg. The symmetric device shows a maximum energy density of 30 Wh/Kg at a power density of 380 W/Kg, which is reduced to 4 Wh/Kg at the highest power density of 4224 W/Kg. Cyclic stability for each device is performed up to 1000 cycles. A Coulombic efficiency of 100 % is observed for both symmetric and asymmetric devices. **(Figure 24)**

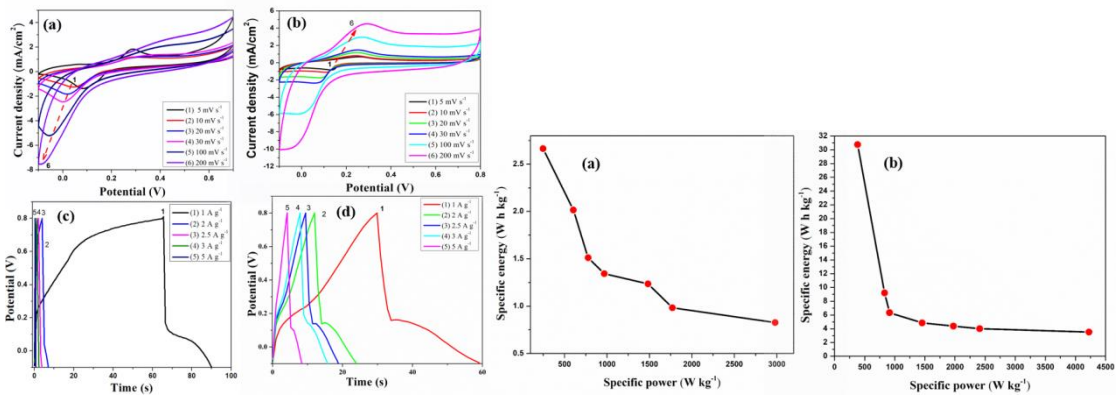


Figure 24 Electrochemical study of CuS nanoparticles in aqueous system.

Alloys Composites and Cellular Materials (ACCM)

Development of open cell aluminum foams for heat sink and EMI Shielding Applications

The schematic diagram for the fabrication of Open-cell Al foams (OCAFs) is shown in **Figure1**. Firstly, 5 wt % of the phenolic resin was used as a binder and added into the acetone and stirring for 1 h. After the complete dissolution of phenolic resin, Al-powder with a 1:1 ratio was added to the acetone-based phenolic resin solution and stirred for 2-hr. Then reticulated PU-foam was impregnated with the Al-acetone slurry. Then pre-sintering was done at 400^{o}C for 1 hr in a controlled atmosphere with a heating rate of 5^{o}C/minute for the removal of PU. Al foams sintered in vacuum furnace (10^{-5} mbar) at 650^{o}C for 3 hr.

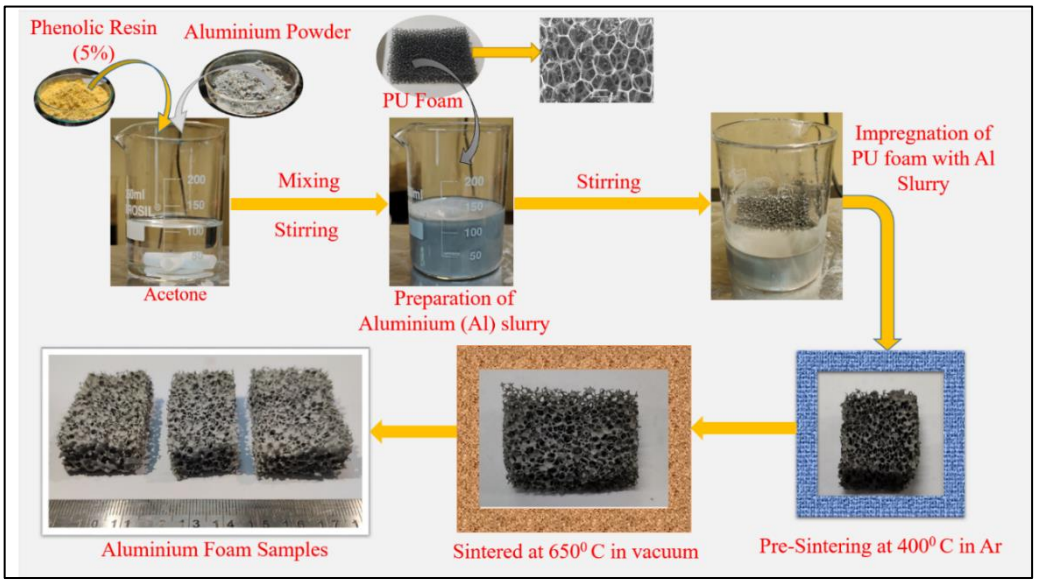


Figure 1. Schematic diagram of making of Al open cell foam through template route

The electrical conductivity of OCAFs at different PPI is shown in **Figure 2(a).** It is evident from this figure that with an increase in the PPI of foam the electrical conductivity of foam increases. This is mainly due to an increase in RD of foam with an increase in PPI.**Figure 2(b)** shows the thermal conductivity of OCAF at different PPIs. From Figure 2(b) it is observed that with an increase in PPI of foam (that is moving from 10 to 30 PPI), the thermal conductivity also gets increased. With an increase in the PPI of the foam, the number of struts per unit volume gets also increase. **Figure 2(c)** shows the uniaxial compressive stress-strain graph of different PPI OCAF. With an increase in the PPI of the foam, the compressive strength of the foam gets also increases. **Figure. 2(d)** shows the energy absorption graph for different PPI of foam. From this graph, it is found that energy

absorptionfor OCAF-30 is more as compared to OCAF-10. Though with an increase in the PPI of foam, the porosity of foam gets decreases which helps in increase the energy of the foam. The plateau stress(σ_{pl}) and young's modulus (E^*) of different PPI OCAF is shown in **Figure 2 (e and f).** Through figures, it is found that with an increase in the PPI of the foam the σ_{pl}andE^* of the foam get increased.

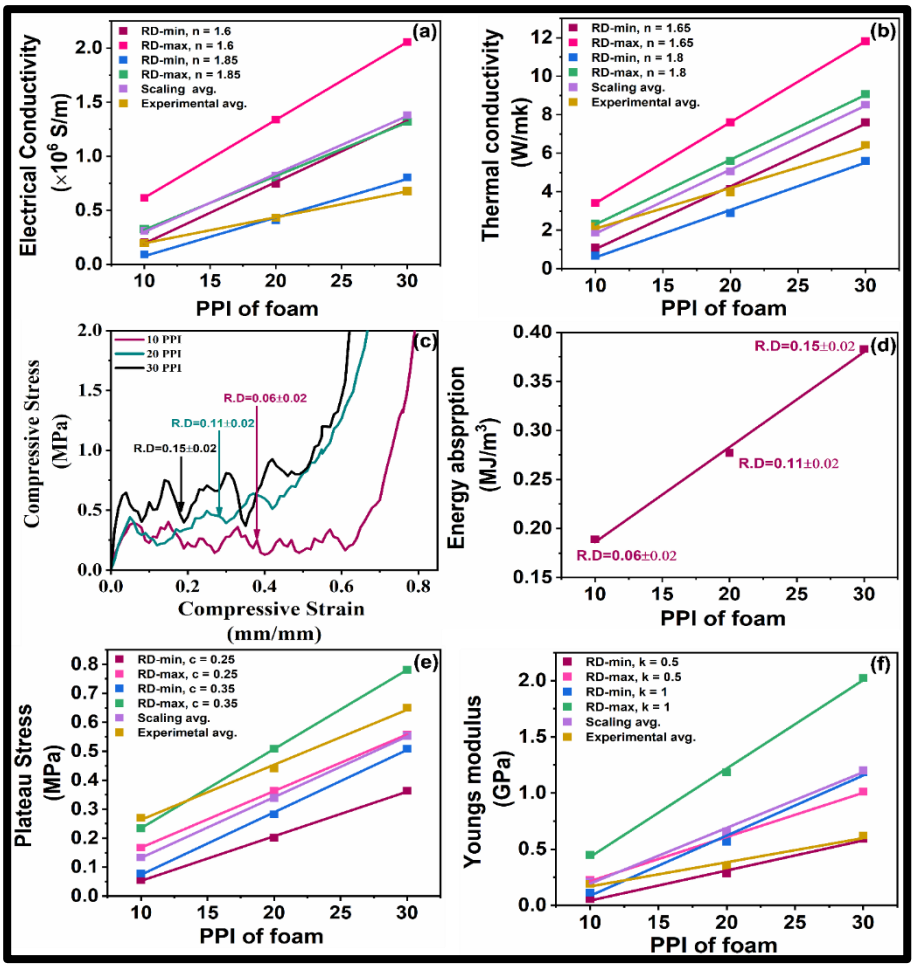


Figure2. (a) electrical conductivity, (b) thermal conductivity (c) compressive stress-strain fordifferent PPI OCAF and (d) energy absorption and plateau stress of OCAF, (e) Plateau stress and (f) Youngs modulus

Design, development and supply of closed cell aluminum hybrid foams

Ordinance development cell-Ordinance factory Medak (ODC-OFMK) is developing Futuristic Infantry Combat Vehicles (FICVs) with enhanced mine blast resistance. CSIR-AMPRI has developed aluminum hybrid closed cell foam reinforced with nano materials such as CNT/Graphene, which

pocesses improved strength (~15-25 MPa), and energy absorption (8-15Mj/m^3). Based on the existing test results it was hypothesizedthat, in the form of foam core sandwich panels, AMPRI developed foams can absorb huge amount of impact energy, which can be a good material for blast mitigation applications.

AA5083+10% SiC+0.2 % CNT hybrid foam has been made in the foam of 30 kg foam castings. The developed foam has been characterized for compressive properties at quasi static and high strain rates. The average plateau strength is ~10 and 15 MPa for quasi static and high strain rate (~800/s) respectively. Microscopy was carried out to study the foam morphology also Raman study was carried out to evaluate CNT distribution within the foam matrix.

ODC-OFMK has developed one scale down blast test rig to conduct the blast test. The similar blast test conditions were simulated through LS_Dyna software using 100 g TNT as blast source. Simulation results indicates that two configurations of sandwich foam panel are capable to absorb maximum amount of 100g of TNT blast energy. Based on the simulation results Aluminum foam core hybrid foam panels with aluminum (AA6061- T6) and SS316L face sheets **(Figure. 3 a)** were made and supplied to ODF–OFMK for testing of the intended scale down test rig. Additionally, bare foam panels of size 250 x 250 x 40mm **(Figure 3b)** and one big panel of size 650x650x30mm **(Figure. 3c)** were also supplied to ODC-OFMK for further blast testing and evaluation.

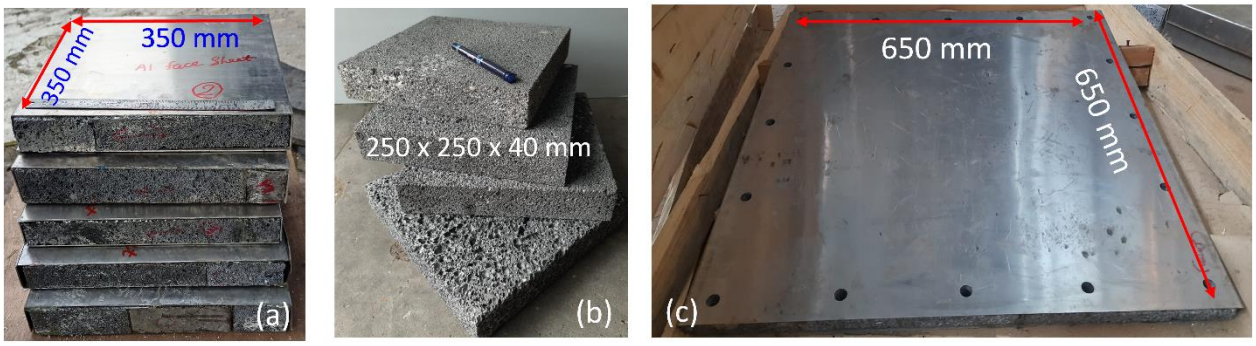


Figure.3 (a) Hybrid foam core sandwich panels with Al and SS316Lface sheets (b) Bare Al hybrid foam panels (c) large size foam panel with Aluminum face sheet

Lightweight carbon foam as an electrode for lead acid batteries

We have developed carbon foam with the rectangular size of 150x150x10 $mm^{3,}$ and developed carbon foam that has been characterized for various properties. Further, the electrical, mechanical, and thermal properties of carbon foams were enhanced by incorporating the carbon nanofibers, graphene and other industrial waste such as red mud, and slag. The developed carbon foam has been utilized

for lead-acid battery electrodes, EMI shielding, and thermal applications. For electrochemical performance, the carbon foam was coated with $PbO_2$and foam connectivity with SS mesh has been made and then demonstrated for cyclic voltammetry, charge-discharge capacity, and impedance. The microstructure and electrochemical performance of carbon foam are shown in **Figure.4**. The capacity of lead oxide coated carbon foam was observed ~ 90 Ah up to 1000 cycles. Besides this, the developed carbon foam exhibited excellent absorption-dominant with an EMI SE of 51.4 dB and a specific EMI SE of ~750dB cm^2 g^{-1} at only 0.35 g cm^{-3} density. Thus, the lightweight carbon foam is a promising material for lightweight lead-acid batteries, aerospace, and next-generation smart devices.

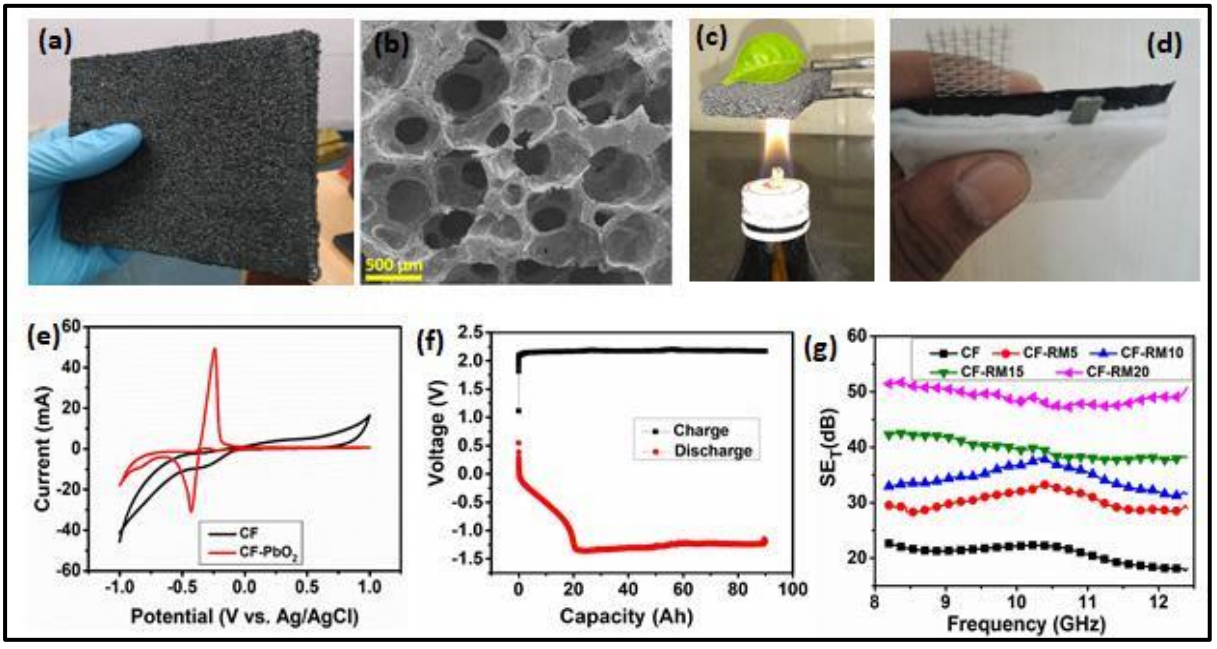


Figure. 4 (a) Photographic image (b) SEM image and (c) fire resistant performance of carbon foam, (d) carbon foam based lead acid battery cell (e) cyclic voltammetry and (f) charge discharge capacity of lead oxide coated carbon foam and (g) EMI SE of red-mud incorporated carbon foam.

Fabrication of carbon nanotube-metal oxides based nanoarchitecture as a flexible anode for lithium-ion batteries

An optimized process for making flexible carbon anode with control size and desired porosity has been developed. Flexible anode thickness in the range of 0.2 to 0.5 mm and resection up to 50 mm diameter has been synthesized. Metal oxides nanoparticles (e.g. Fe_3O_4, Co_3O_4, NiO and SnO_2) has been synthesized and decorated on porous carbon. Porous carbon decorated with Co_3O_4nanoparticles has been developed and tested for electrochemical performance. The porous carbon decorated with 7

% Co_3O_4 NPs (CF-7Co_3O_4) demonstrates an excellent specific capacitance of 302 Fg^{-1} at the scan rate of 5 mVs^{-1} and good cyclic stability and rate performance when used as an electrode for supercapacitors. **(Figure 5)**

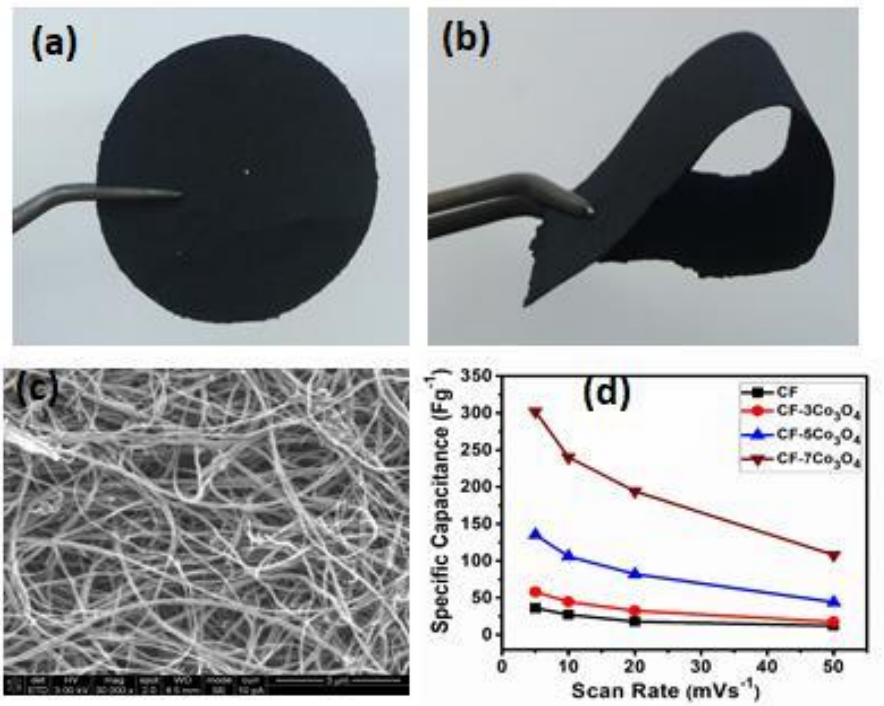


Figure. 5. (a) and (b) photographic image, (c) FESEM image of MWCNTs based flexible carbon and (d) specific capacitance of CF-Co_3O_4 decorated porous carbon at various scan rate.

High strength, creep and corrosion resistance RE-TE added magnesium Alloys

The facility and expertise developed for making RE and TE added magnesium alloys. Presently at a time 35 kg of magnesium alloys could be prepared. A series of RE added into the alloy and it was found that Yr, Nd, Nb, Zr and Sc are most effective RE for grain refinement and improvement in strength and corrosion resistance. The tensile strength of magnesium alloys (ZA91) after casting is noted to be 150 MPa, which is increased to 175-190 MPa due to addition of 0.5 wt% RE. but after forging and rolling the yield strength of the RE-added alloys increased to 230 to 260 MPa and UTS increased to 350 to 375 MPa. The corrosion resistance is improved to 0.5 mmpy. For further improvement in corrosion resistance the alloys are subjected to anodising. It is improved by an order. The attempts have also been made to make SiC reinforced AZ91-Re-SiC composites, which showed significant improvement in hardness and yield strength. These could be used for automobiles and engineering applications.

Bio-Inspired Surface Functionalization of Carbon Nanostructures with Catecholamine/Catechol Rich Polymers: Novel Approach to Develop Advance Biosensors

Biosensors opened up a new horizon in fast, sensitive and selective detection of the disease, reducing interval time between sampling and diagnostic result. In this project, a new material-based strategy to design highly sensitive DNA based electrochemical TB biosensor using smart conducting nanocomposite constituted of carbon nanomaterials (CN; Graphene, Carbon Nanotubes, Carbon Dots), metal nanoparticles (MNP) and catechol/catecholamine rich polymers [CRP; e.g. Polydopamine (pDA)] has been investigated. Discovered in 2007, pDA surface modification has been emerged as very efficient and universal approach in modifying and functionalizing any material surface without hampering their intrinsic properties. Under this project, the pDA coated reduced graphene oxide composite with good electron transfer properties have been chemically synthesized and characterized using various sophisticated techniques **(Figure 6).** The designed composite material is not under investigation to design electrochemical sensing system for heavy metal detection and electrochemical biosensor system for *M. tuberculosis* sensing.

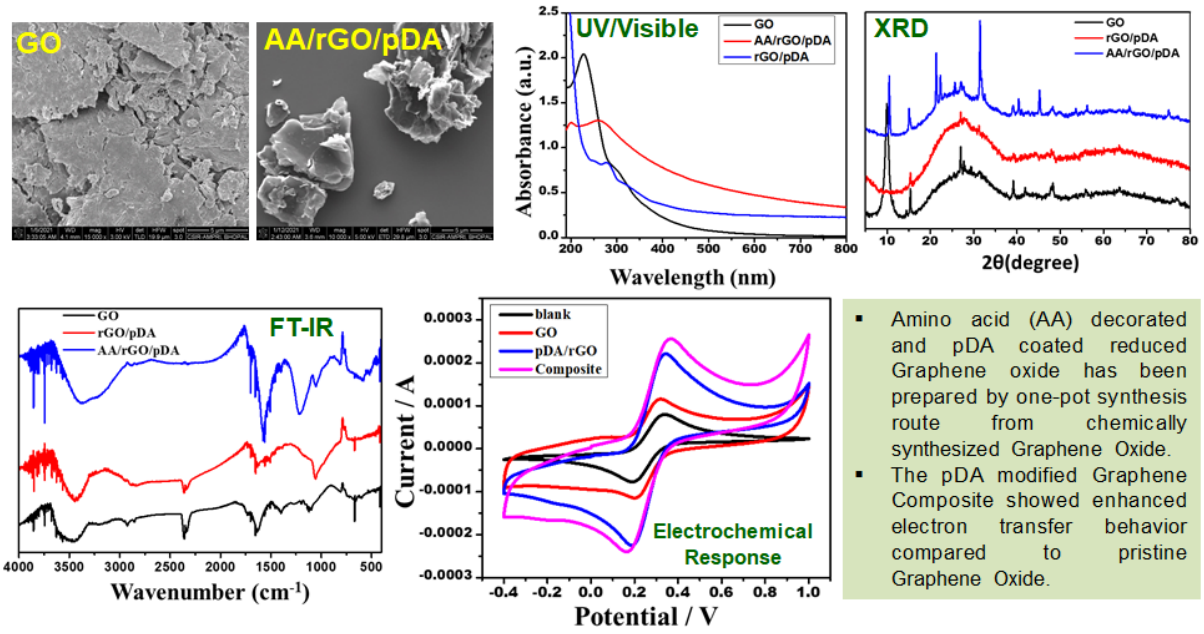


Figure 6: SEM, UV-Visible, XRD, FT-IR and Electrochemical response of polydopamine coated reduced graphene oxide.

Development of Nanofibrous Antimicrobial Wound Dressings for Chronic Wound Infections and Skin Regeneration

Globally, chronic wounds, like burn wounds and diabetic foot ulcers, impose a notable burden to patients and healthcare systems. Such non-healing wounds are readily subjected to bacteria that provoke inflammation and hence challenge the healing process. Furthermore, bacteria induce infection impeding re-epithelialization and collagen synthesis, thereby increasing hospital stay and costs. Thus, there is urgent need for advanced wound dressing (AWD) materials that alleviate infection incidence and accelerate the healing process. Electrospun biopolymeric nanofiber revealed promising potential towards the development of advanced wound dressings materials due to their high surface area, biocompatibility and their 3D nanoporous morphology mimicking the extracellular matrix. Further, nanofibrous dressings provides unique structural features that helps enhancing haemostasis, wound exudate absorption, gas permeation, cell proliferation and controlling infections by drug delivery at wound milieu. Due to the emergence of multi-drug resistant bacterial strains, there is also pressing clinical demand to develop antibiotic free infection controlling alternatives. With this background, in this project we are focussing on developing antibiotic free prototype wound dressings, using electrospinning technique, combining the beneficial effects of i) Polycaprolactone (PCL)/Gelatin hybrid nanofiber system, ii) Epsilon-polylysine and graphene oxide as antimicrobial and iii) bio-inspired polydopamine crosslinking method.

Intelligent Materials and Advanced Processes

Design and Development of Smart, Hybrid Polymer Composites and Structures for Advanced Engineering Applications

A system of SMA and SMP will be designed in such a way that the recovery force generated by SMA during the end of one thermal cycle could be used to deform the SMP for the next cycle, thus forming a chain of automatic activations that is entirely thermally generated without the aid of mechanical deformation. This kind of a system can be used to make a thermally activated smart valve. Shape set SMA extension springs are stretched and attached across the diameter of the SMP tube. A sealed mould for SMA wire and SMP resin setting made on a wooden block and stainless steel sheets. The SMA wire has been fixed in mould as shown in **Figure. 1**. SMP resin pouring is remaining. The load test of Ni-Ti SMA wire in the mould with linear arrangement has been completed. The load bearing capacity of the SMA wires was found to be 40 N with a current of 7-8 Amperes at 20 V. The mould for SMA and SMP setting has been completed.

Figure. 1: SMA wire gage and its load testing

Development of joining process for industrial components through electromagnetic forming

Comparative formability study of two Al alloys (AA5754 and AA6061) is carried out. Punch stretch test (PST) and Electrohydraulic forming free-form deformation (EHF-FFD) of the sheets were performed using suitably designed tooling. **Figure. 2** shows the comparative study of formability at quasi-static and high strain rate for AA6061 material. It shows clearly the improvement in formability for AA6061 material at high strain rate as compared to quasi-static testing.

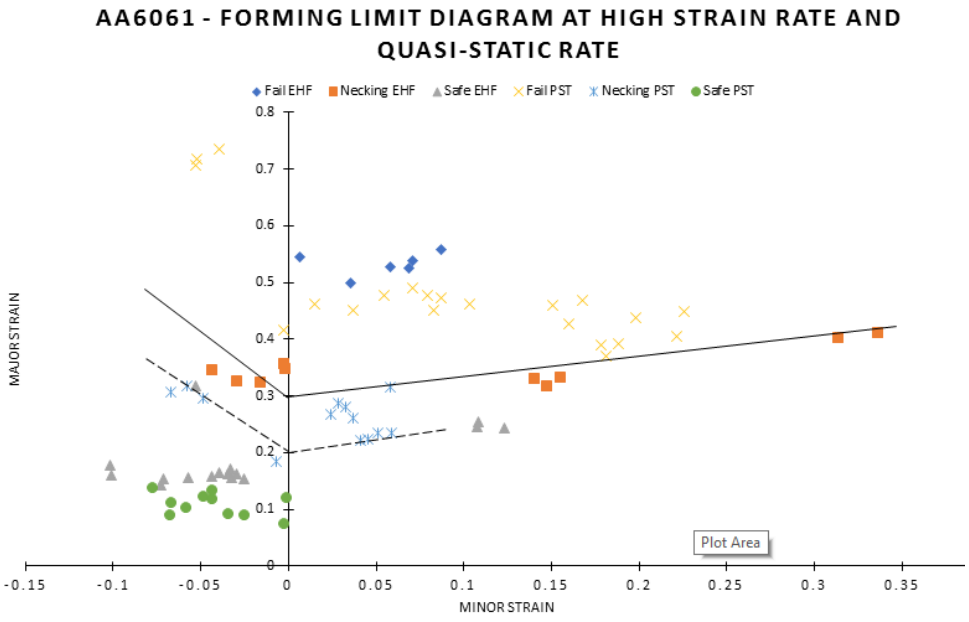


Figure. 2: Forming limit curve for AA6061 at quasi-static and high strain rate.

Another activity was joining of lug with cable through electromagnetic joining process. In the conventional crimping processes lugs and cables are joined by using a mechanical / hydraulic crimping tool. The ends of a cable is stripped and placed inside a lug then the mechanical force is applied to deform the lug and join where the wire is inserted. Aluminum and Copper, being dissimilar metals, are difficult to crimp/join through conventional process. The lugs and cables crimped through conventional process have poor surface finish and poor strength. To overcome these problems, electromagnetic crimping can prove to be beneficial as it can efficiently join dissimilar combination of lugs and cables and provide higher strength, better surface finish and lower resistance. **Figure 3** shows an electromagnetically joined sample.

Figure 3. Electromagnetically crimped lug-cable sample

Development of experimental setup for Investigation, recording, and testing of electromagnetic signals from magnetic photons in homeopathy medicines and other test samples

Electro-magnetic signals characteristic of substance/test sample measured under the influence of electromagnetic field of uniform power spectral density at variable frequency. Experimental setup equipped with signal generator (function generator), excitation and sensing coil, Mu-metal, analyzer probe, spectrum analyzer and MCS Software for data acquisition. The external supply of 10 Vp-p of selected frequency is given from function generator to the primary coil. The primary coil is designed for 300-ohm impedance and inductance 390 mH. EM Signal generated from the primary coil that travelled through the samples while secondary coil is used to capture the signal and recorded in DAS. Mu-metal is a nickel-iron based soft ferromagnetic alloy that has very high permeability. It is generally applied in shielding the sensitive electronic equipment against static or low frequency magnetic field **Figure.4**. shows the developed Magnetic Field Shielding box with concentric coils. Recorded electromagnetic signals from secondary coil are analyzed to extract the required information from the test samples. The copper coils are designed and developed indigenously based on Co-centric / Coplanar Method. This type of coil incorporates two different coils (excitation and sensing coils) of unequal diameters which are aligned on the same centre. Bobbin is designed using Cura software and fabricated with the help of Ultimaker 3D printer.

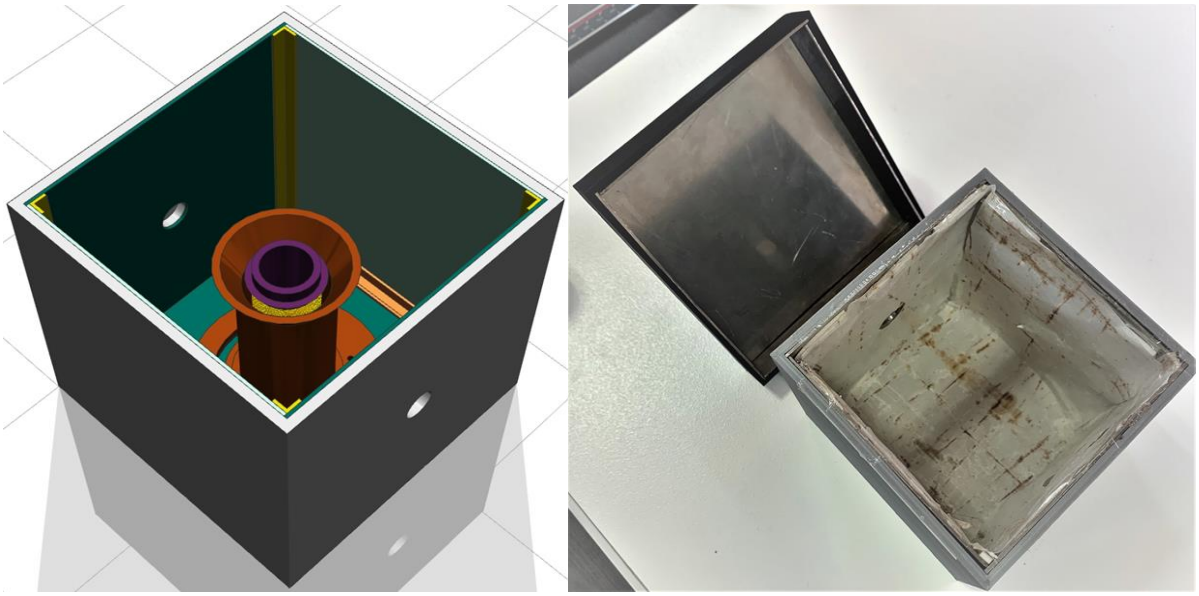


Figure. 4. Magnetic Field Shielding box with concentric coils.

300 Hz frequency is considered for homeopathy medicine characterization. It is observed from **Figure. 5** that the results of 5X-6X potencies are not resolved very clearly. It requires further optimization of process to get the precise results within the permissible or the acceptable limit.

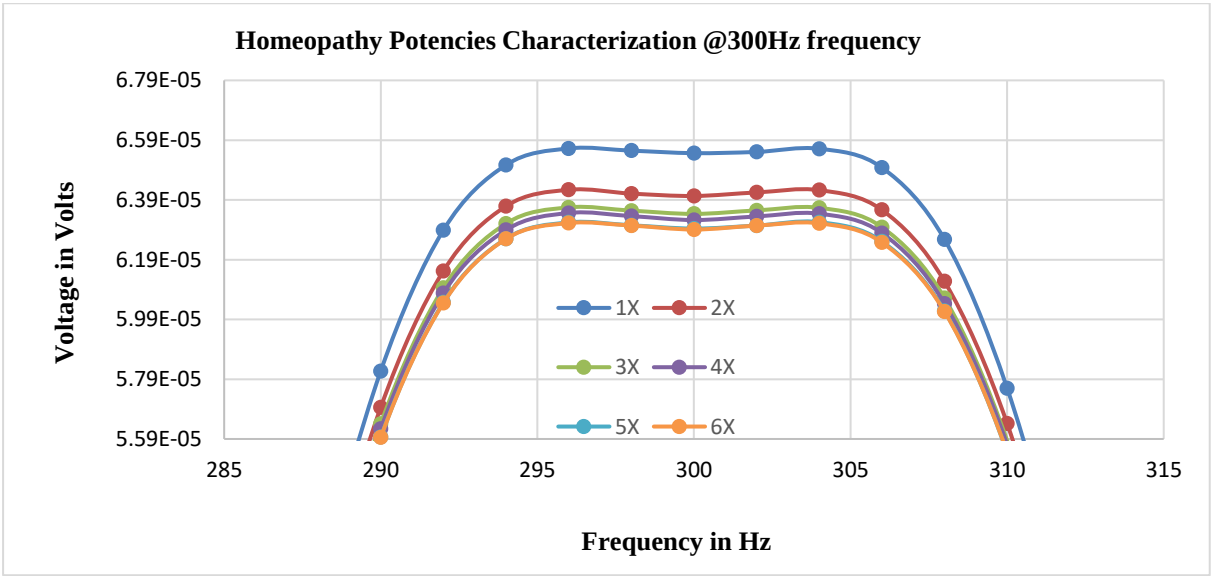
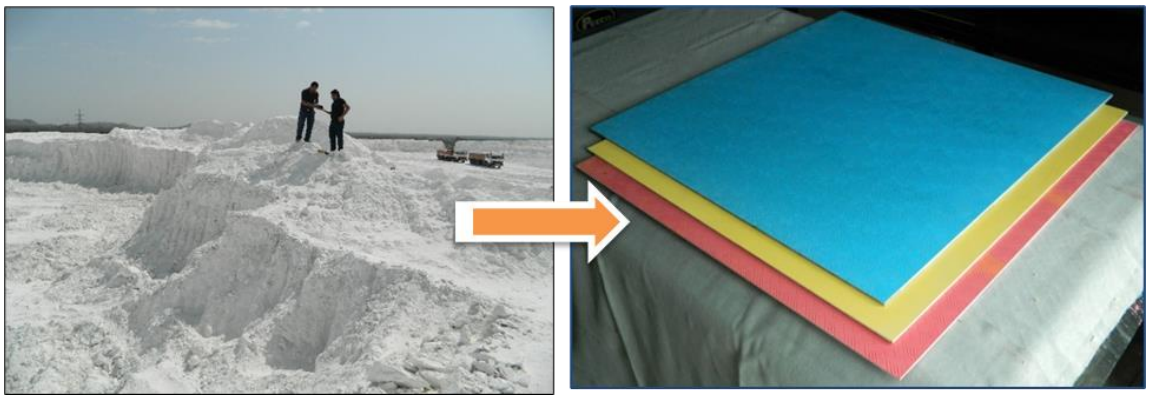


Figure 5. Characterization of Homeopathy Potencies

Hybrid Building Materials and Manufacturing (HBMM) Division

Manufacturing hybrid and high-performance green composite materials from marble, granite and stone waste stream



Marble waste stream: Survey and collection from Rajasthan and converted into hybrid composite for multifunctional applications

The principal objective of this program is to recycle marble, granite and stone waste stream for the development of advanced hybrid green composite materials for diverse applications as alternative to timber, synthetic wood, GRP and plastic products. The framework of the project and its scope encompasses:

- Survey and collection of marble, granite and stone waste stream in the state of Rajasthan and Madhya Pradesh. Property characterization and implementing sustainable waste management strategy
- Lab scale experiments, synthesis and fabrication of composites materials using marble, granite and stone waste stream and their performance evaluation and validation
- Process optimization and pilot scale manufacturing to achieve composites' target specifications as a civil engineering infrastructure material
- Life cycle assessment and weathering/durability characteristics of hybrid green composite materials developed from marble, granite and stone waste stream
- Showcasing and dissemination of research findings among entrepreneurs and general public through participation in exhibitions, conferences, industrial linkages and business development,
- Networking with industries, technology transfer and exploring commercialization opportunities.

A comprehensive field work including detailed survey and collection of marble, granite and stone waste samples from seven different districts (Chittorgarh, Makrana, Jaipur, Udaipur, Rajsamand, Kota and Kishangarh) in Rajasthan has been done. About 22 locations with their GPS coordinates in these 7 districts were surveyed from where samples of marble waste (15 nos.), granite waste (6 nos.), marble & granite mix waste (2 nos.), stone waste (6 nos.), soil (2 nos.) and water samples (9 nos.) were collected. In Madhya Pradesh, samples of marble (5 nos.), granite (4 nos.), stone (10 nos.) waste along with water samples (8 nos.) were also collected from four districts of Narsinghpur, Jabalpur, Khajuraho and Katni.

Efforts have been put to create a state-of-the-art facility for the characterization of collected waste samples, preparation and fabrication (lab scale and pilot-scale) of composite samples and their characterization in different polymeric system . Some of the major equipment include, Injection moulding machine, Compression moulding machine, X-Ray Fluorescence Spectrometer, Weatherometer, Planetary Ball Milling machine, Thermal Analyzer, Ion Analyzer, etc. High speed mixing and calendaring system.

Processing and characterization of Marble waste stream

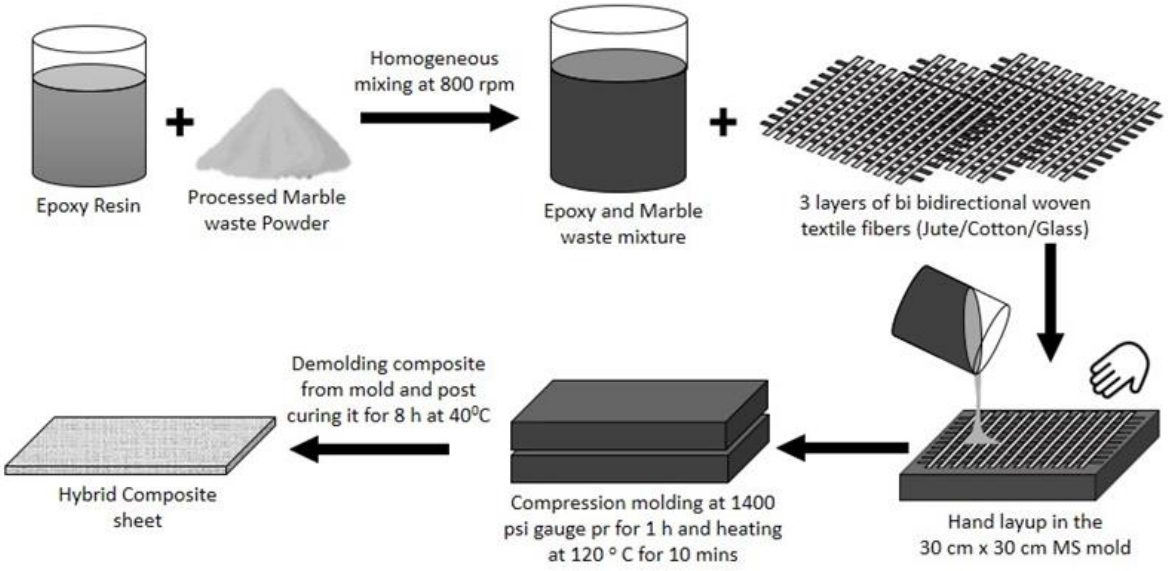
The processing and characterization (physical, chemical, thermal, morphological, mineralogy) of marble, granite, stone waste samples have been completed. The bulk density of marble waste samples from Rajasthan ranged between 1.26–1.69 g/cm3, specific gravity between 2.32–2.67 and porosity between 30.63–47.67 %. In case of granite, the bulk density ranged from 1.07 to 1.53 g/cm3, specific gravity between 2.39–2.67 and porosity from 28.92 to 56.02 %. The bulk density of different stone waste samples ranged from 1.30–1.59 g/cm3, specific gravity between 2.52–2.66 and porosity between 31.39–45.10 %. In marble, principal minerals were identified to be Calcite and Dolomite with small presence of Quartz, Actinolite and Muscovite. Quartz was found to be chief mineral in granite samples while Calcite to be in stone waste samples. The presence of these minerals was further confirmed with FTIR spectroscopy and thermogravimetric analysis. For samples collected from Madhya Pradesh, the bulk density of marble waste samples varied between 1.31–1.65 g/cm3, specific gravity between 2.42–2.56 and porosity between 31–48 %. In case of granite, the bulk density ranged from 1.56 to 1.81 g/cm3, specific gravity between 2.45–2.51 and porosity from 27 to 38 %. The bulk density of different stone waste samples ranged from 0.70–1.24 g/cm3, specific gravity between 2.35–2.61 and porosity between 51–72 %. The thermogravimetric analyses and FTIR spectroscopic analyses suggested the presence of Dolomite as principal mineral in marble while

Quartz in granite. In case of majority of stone waste samples, Talc and Magnesite seemed to be principal constituents.

The water samples collected from both states exhibited above the neutral pH. Three samples showed slightly acidic character as their pH ranged between 6.2 and 6.64. Highest pH of 8.7 was recorded for sample collected from Jaipur granite processing industry. All samples from MP had very low hardness values, three samples in particular from Rajasthan had relatively much higher total hardness values. In terms of calcium content, samples of MP showed much higher values as compared to those from Rajasthan.

Manufacturing thermoset polymer composites materials

Hybrid green composite materials were developed using more than 65% marble waste particulates as filler material in epoxy resin / polyester resin system. Different types of natural textile fibres (cotton and jute) / synthetic textile fibres (Glass and Nylon) have been used as reinforcing materials under compression moulding system.



Schematic diagram of composites manufacturing

The findings of the research revealed that the density of the composites varied from 1.56 g/cm3 to 1.70 g/cm3 while very low water absorption uptake was observed except in the case of jute fibre reinforced composite, although the increase was only 0.7 %. The tensile modulus was highest in the case of composite made just from marble waste and epoxy. The tensile strength in general showed higher than 21 MPa while flexural strength of between 34–50 MPa with jute textile fibre reinforcement.

Hybrid green composites were fabricated using a compression moulding with epoxy as the matrix, granite powder as filler material (up to 70 wt.%) and woven mats of jute fibres (0, 2 and 4 layers) as the reinforcing material, affording a total of 12 different composites. The addition of granite significantly reduced the water absorption and increased the density. The composites containing 60 wt.% granite and 4 layers of jute fibres mat exhibited water absorption of only 0.09 %. In terms of mechanical properties (flexural and tensile), the hybrid composites exhibited significant improvement over pure epoxy. The results indicated an overall synergistic effect of jute fibres and granite particles combination on composites' properties, however, glass textile fiber reinforcement have showed maximum strength .**(Figure 1)**

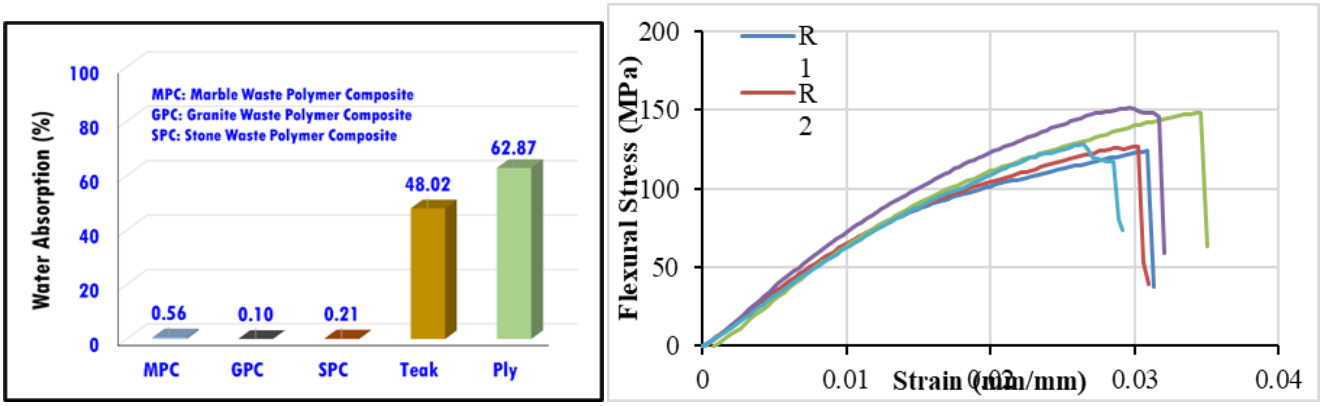


Figure 1: Water absorption capacity and Flexural strength test results of the glass fibre and marble waste reinforced composite in epoxy resin system

Hybrid green composites were also prepared using Kota stone waste particles (up to 60 wt.%) in combination with woven jute fibres (1, 2 and 3 layers) and epoxy as the matrix. All composites showed very low water absorption and the thickness swelling (< 1 %). Highest value thickness swelling (1.048 %) was seen in composite with 60% stone and 3 layers of jute in it. The density of composites increased up to 1.7 g/cm3 at 60 wt.% stone waste. The tensile tests revealed synergistic effect by stone waste particles. Adding 3 layers of jute in composite with 30 wt.% stone led to ~ 39 % increase in tensile strength whereas adding 3 layers of jute in composite with 60 wt.% stone led to ~ 43 % increase. When 30 wt.% stone waste was

added in the composites, the flexural strength increased continuously upon increasing the fibre content in it. The highest impact strength value (2.38 KJ/m2) was obtained for composite containing 60 wt. % stone waste and 3 layers of jute closely followed by 2.35 KJ/m2 exhibited by composite containing 30 wt. % stone waste and 3 layers of jute. A noticeable decrease in volume resistivity was observed as the amount of stone filler increased. In terms of thermal conductivity, an increment was observed with maximum observed in the case of composites with highest amount of stone waste. While thermal conductivity of epoxy was recorded to be 0.193 W/m.K, in case of composites it reached up to 0.428 W/m.K at 2 jute layers and 60 wt.% stone waste filler.

Microstructure of the cross section of hybrid composites were studied using FE-SEM. In **Figure 2 (a)** shows the bonded marble waste particle with the jute fibril in epoxy resin having good bonding. **Figure 2 (b)** shows the fibre and the matrix wetting performance in the fibre's matrix. Some pores were attributed due to the air bubbles trapped in matrix during the high shear viscous mixing. The FT-IR spectra shows the hybrid composites made of glass, jute and cotton textile with marble waste particulates in epoxy resin deducted under ATR technique on surface characteristic. The bands observed are common in all spectra. 3320-2270 cm-1 represents O-H stretching. 3062-3036 cm -1 represents stretching of C-H of oxirane ring. 2961-2865 cm-1 bands represent stretching of C-H and CH aromatic and aliphatic. 1717 cm-1 band represents stretching in C=O bond. 1606-1581 cm-1 is the stretching in C=C aromatic ring from epoxy. 1507 cm-1 is the stretching in C-C of aromatic ring from epoxy. 1032-1104 cm-1 represents the stretching in C-O-C of ethers. 873 cm-1 represents out of plane bending of carbonate group from marble waste particulates and 826 cm-1 represent the stretching C-O-C of oxirane group. 768 cm-1 represent rocking CH2 group.

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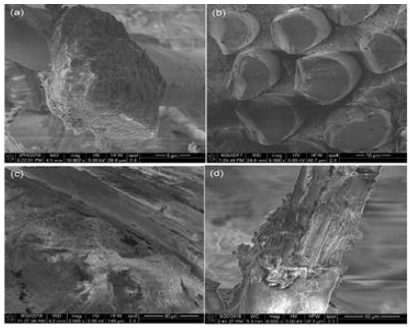
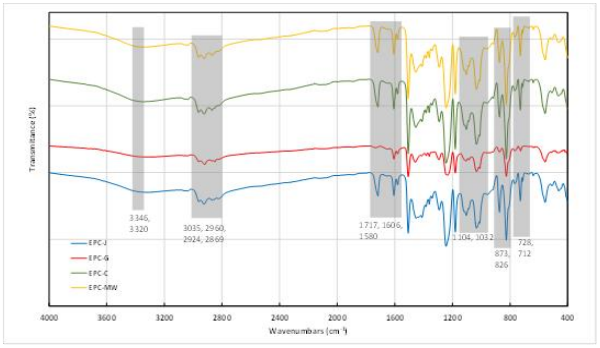




2(a) Microstructure of hybrid composites

2(b) FT-IR spectra of cross-sections of composite samples

Figure 2

Development of thermoplastic composites using marble waste stream

Experiments have been done to study the scope of marble waste particles as filler in for making flexible plasticized poly(vinyl chloride) (PVC). Flexible PVC sheets were prepared using a two-roll mill at two plasticizer concentrations (16, 30 phr) with varying amount of marble waste (5–40 phr) and commercial uncoated precipitated calcium carbonate (PCC) (5–40 phr). The results of tensile tests indicated that an inevitable decrease in tensile strength due to un-coated filler utilization, however the values were still comparable to PCC. While at lower 16 phr tensile strength of samples containing uncoated PCC was higher, at higher 30 phr, samples containing marble waste exhibited higher tensile strength. Water absorption tests were carried out at an elevated temperature (60oC) for extended period of time. While samples containing fillers exhibited showed higher water absorption at lower plasticizer content, at 30 phr the samples filled with respective fillers showed reduced water absorption as compared to neat PVC (3.31 % for PVC; 2.67 % for PVC-Marble-30; 95 hours). These preliminary findings indicate that there's significant potential for marble waste to be used as primary filler for both plasticized and un-plasticized PVC formulations.

Efforts were also made to use of marble waste for making moisture resistant and thermally insulative hybrid thermoplastic polymer composites using polypropylene resin. The mechanism and understanding the use of calcium-rich marble waste particulates (MPs) as economic reinforcement in recyclable polypropylene (PP) to prepare sustainable composites via the injection moulding method were studied. Composite samples were prepared via injection moulding technique with different filler concentrations (0%, 20%, 40%, 60%, and 80%) on weight fraction at temperatures of 160, 180, and 200°C. Detailed analysis of the mechanical and thermal properties of the fabricated composites was carried out. The composites showed a density varying from 0.96 to 1.27g/cm3, while the water absorption capacity was very low at 0.006%–0.034%. Marble waste particulates were found to considerably increase the tensile, as well as flexural, strength of the sustainable composites, which varied from 22.06 to 30.65MPa and 43.27 to 58.11MPa, respectively, for the moulding temperature of 160°C. The impact strength of the sustainable composites was found to surge with the increment in filler concentration, and the maximum impact strength was recorded as 1.66 kJ/m2with 20% particulates reinforcement at a moulding temperature of 200°C. The thermal conductivity of the particulates-reinforced sustainable composites was as low as 0.23Wm−1K−1 at a 200°C moulding temperature with 20% and 40% filler concentrations, and the maximum thermal conductivity was 0.48Wm−1K−1 at a 160°C moulding temperature with 80% filler concentration. The findings have shown a

technically feasible option to use marble wastes for making thermoplastic composite with better mechanical and thermal properties for possible use in electrical and civil infrastructure.

Durability and Wreathing performance of hybrid composites made from marble waste stream

Durability is an extremely important aspect of a material defining its practical usefulness for any application. The developed composites with varied compositions such as those containing only particulates as reinforcement (marble or granite) or those containing additional fiber mats (glass, cotton, jute) were subjected to different chemical environment to test their resistance towards weight change. The composites were subjected to highly acidic (sulfuric acid, hydrochloric acid) conditions (10 M, 5M, 1 M), highly basic (sodium hydroxide) (10 M, 1 M) conditions as well as sea water (Bay of Bengal) conditions at room temperature for 7, 15 and 30 days. The results indicated that the composites exhibit excellent chemical stability and mechanical integrity but also maintain high degree of surface gloss despite long term exposure.

Hybrid composites of epoxy and marble waste (200 wt. %) in non-reinforced and reinforced (3 layers of woven mats of Cotton, Jute and Glass) were subjected to accelerated UV-weathering tests as per ASTM G-154 cycle 7 standard up to 672 hours. For comparison, commercial plywood and MDF board samples were also exposed simultaneously. The exposed samples were periodically surface analyzed and tested for flexural strength. While plywood and MDF board samples completely lost their structural integrity and flexural strength just after 168 hours, hybrid composites exhibited superior weathering resistance. Although the composites lost surface gloss but nonetheless maintained their structural integrity and showed only small decrease in flexural strength and modulus.

Two international patents have been file and granted on this program: (i) A glossy finish sandwich composite and process for preparing the same (Grant No. 201811047389, WO 2020/121319A1) & (ii) High performance glossy finish green composites with variable density and an improved process for making there of (Grant No. 201811016873. W02019/211862A1). Based on these studies, it is concluded that marble, granite and stone waste streams have high potential to be used with both thermoplastic and thermoset polymer so as to fabricate advanced composite materials that have on par performance to commercially available materials with lower cost and reduced environmental footprint. This major research program was carried out with the financial support of DST and CSIR India. Realisation of these technologies has great impact towards achieving the Goal of Government of India on Make in India, Clean India, Skill India and Atmanirbhar Bharat.

Hybrid green composite materials manufactured at CSIR-AMPRI Bhopal using marble wastes (**Figure 3a-3c**)

3 (a): Hybrid composite architectural cladding panels made from marble waste stream

3(b): Hybrid green composites Board made from marble waste stream for furniture applications

3(c) Hybrid sandwich composite Door and Door Frames made from marble waste

Figiure 3

Development and Manufacturing hybrid green composites using industrial and agro wastes in pilot scale and facilitating entrepreneurship

India is the world's second largest producer of paddy, after China, producing approx. 98 million tonnes of paddy with around 130 million tonnes of straw. Punjab produces around 11.27 million tonnes of rice per annum, which is 10.6% of total rice produced in India, also generating about 21 million tonnes of Parali. As per a recent report, around 10,000 stubble burning cases were recorded during October 28 – November 4, 2019, across the country, out of which 80% incidences were from Punjab and Haryana. Despite the ban on Parali burning and implementation of various policies by the National Green Tribunal of India, and the governments of Punjab, Haryana, Uttar Pradesh and others, the incidence of Parali burning has gone up. This indicates non-availability of longlasting, techno-economic and socially acceptable solutions. Open burning of Parali emits heavy amount of numerous toxic gases, including sulphur oxides, carbon dioxide (CO_2), carbon monoxide (CO), methane (CH4), nitrogen oxides (NOX), and, huge amount of particulate matter (PM) into the atmosphere, creating adverse impact on human health, global warming and also on the earth's radiation balance. These contaminants disperse into the surroundings, undergo physical and chemical transformations, and create multiple health hazards including respiratory disorders like asthma, cancer and weakened immune systems. The risk of rapid spread of COVID-19 increases due to the ability of particulate matter to act as virus carriers. The particulate matter can also attack and weaken the human immune system and higher exposure to polluted air may also augment the probability of illness from COVID-19 as has been shown by various researches. **(Figure 4)**

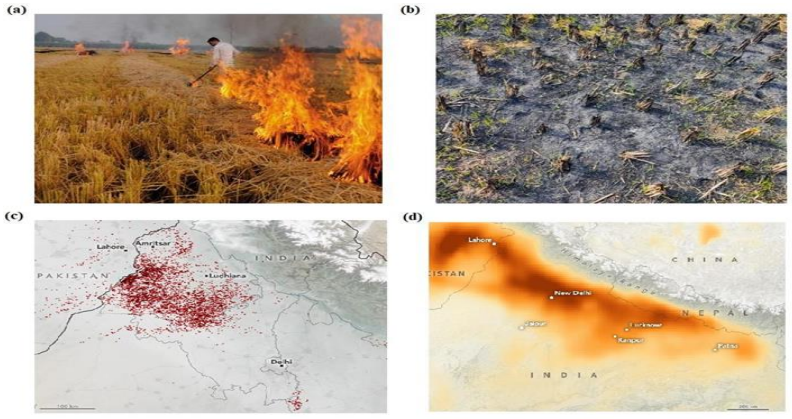


Figure 4.(a-d) Paddy straw burning and NASA stalaite image showing the location of burning paddy straw

Working to this end, Hybrid building materials and manufacturing division CSIR-AMPRI (Advanced Materials and Process Research Institute), Bhopal, who have been working on multidisciplinary research in providing holistic solutions for the industrial and societal development with great environmental significance, have successfully converted the Parali into a novel green hybrid India Gate covered in heavy smog Image. These Parali-based products can turn out to be real game-changers for farmers and start-ups, offering them a new economic outlet and helping generate employment. The story of this innovation began when a team of scientists from CSIRAMPRI, Bhopal, visited village SunheriKhalsa of Thanesar tehsil in Kurukshetra district in Haryana to explore the possibility of converting Parali into useful materials at pilot scale through commercially viable technology. CSIRAMPRI also collaborated with National Institute of Technology (NIT), Kurukshetra, to explore the possibility of utilising agro-wastes in various other applications by interacting with local farmers and administrative bodies. During this visit, the raw material, i.e. Parali, was collected from local area and quick preliminary feasibility experiments for converting it into valueadded products at CSIR-AMPRI were performed. Paddy straw (Parali) contains 34% crystalline cellulose, 6.54% hemicellulose and 41.90% lignin. After extensive characterisation and optimisation of paddy straw, the researchers at AMPRI developed a technology for successfully converting this agro-waste into termite and fungus resistant unlaminated hybrid composite particle boards. These novel green hybrid materials can be used as wood substitute and also as an alternative to medium density boards for use in civil infrastructure and domestic applications. The developed products showed excellent mechanical strength, bending strength and water absorption properties compared to conventional and commercial particle board. (Table 1) Glossy finish with designer texture on the surface of laminated/sandwich structure of Parali-based particle board have also been developed for interior and decorative applications. This innovative technology and translational research would provide a sustainable solution for the problem of Parali burning, which is responsible for creating air pollution in Delhi and neighbouring states. To build-up confidence among industries, we have scaled up this technology for the first time commercially and production of unlaminated and laminated boards of various thickness has been carried out at CSIR-AMPRI, Bhopal. A business model may be planned for generating employment for i) local farmers and people for collecting Parali residues and their processing, ii) for engineers for manufacturing these hybrid green particle boards and iii) for traders to sell and exploit various applications of hybrid composites as wood alternative and plywoods. AN OPPORTUNITY FOR ATMA NIRBHAR BHARAT The CSIR-AMPRI

technology is an excellent opportunity to work towards making the country self-reliant postCOVID-19. Presently, India imports wood particle board from 40 different countries, of total value of 39.1 million USD, according to a trade report of 2019. The hybrid composite can help in effectively minimising this import. Realisation of the CSIR-AMPRI technology in commercial operation will certainly create employment and income for rural as well as urban people and provide additional income to farmers in cash by selling the Parali and also substantially reduce the air pollution and environmental problems associated with burning of the paddy straw not only in Delhi, NCR, Punjab and Haryana but can be useful for rest of the world over Post-COVID-19. This will significantly contribute in generating employment opportunities for grain bowl states of the country in the current situation of COVID-19 crisis. This would be enormously beneficial in enhancing livelihood opportunities for general public **(Figure 5 and 6).**

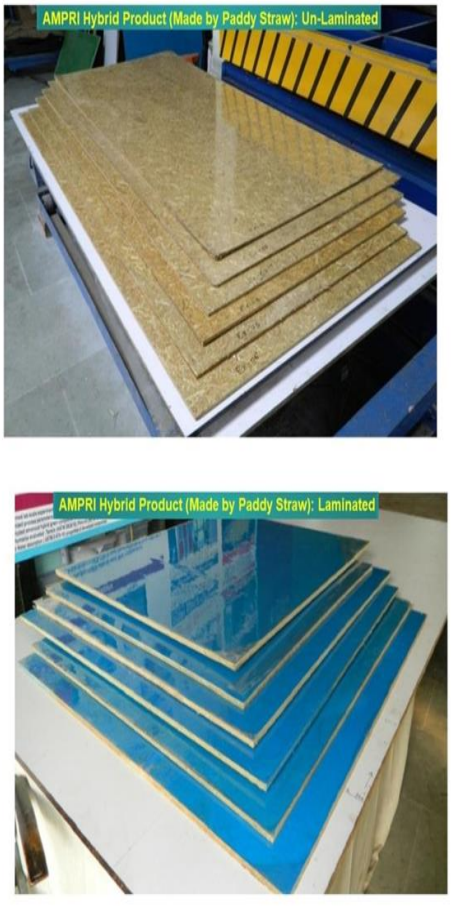


Figure 5. Unlaminated and Laminated and hybrid composite developed by paddy straw

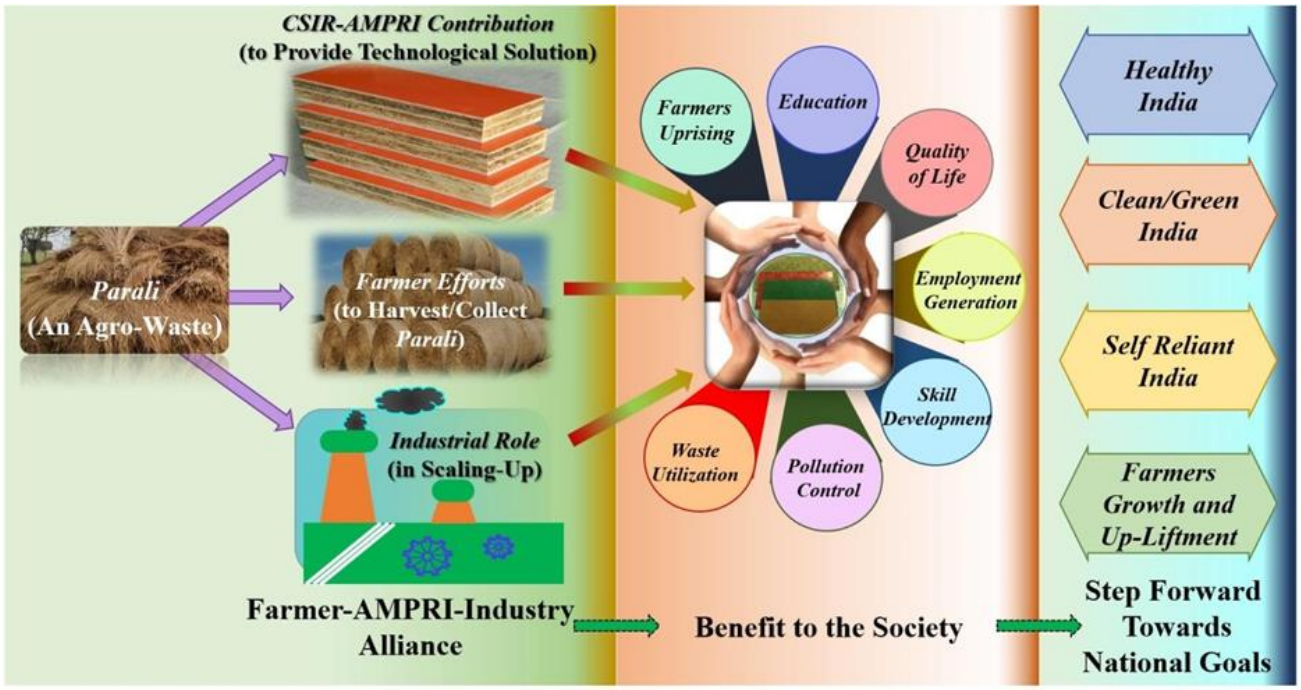


Figure 6: Road map of the developed by paddy straw technology towards achieving National goals

Table 1: Property of the paddy straw developed products

Material performance (average value)	Tensile Strength (MPa)	Tensile Modulus (GPa)	Flexural Strength (MPa)	Flexural Modulus (GPa)	Density (g/cm^3)	Thickness Swelling (%)	Water Absorption (%)
Un-laminated Board a	23.50	3.13	32.56	3.17	0.935	14.41	35.65
Laminated Board a	26.26	3.78	32.65	4.20	1.190	8.35	8.32
Particle Board 1	21.61	2.16	17.14	2.18	0.670	31.62	65.00
MDF Board 2	15.78	2.26	27.12	2.51	0.700	19.26	19.00

The innovative composite materials have a variety of application potential for infrastructure in the construction sector, locomotive (train) and other transport systems (Bus, ship,etc.) and infrastructure as doors, false ceilings, flooring, architectural wall panels, partition and furniture etc. The evergreen hybrid ply and composite wood are stronger and environmental-friendly. “It is resistant to weather, corrosion, water, moisture and is a termite and fungus free composite. The composite materials are fire retardant, self- extinguishing in nature, cost effective and maintenance free materials. Evergreen Hybrid Ply and Composite Wood has potential to be used as an alternate material for wood / timber, plastic, synthetic wood such as MDF Board, particle board and ply wood and all other conventional materials used in the furniture industry. Addition of agro-industrial wastes particulates and fibres enhance the surface finish, density, flexural modulus and resistance to abrasion” says the statement issued by the institution. Recently the technology transfer has been done by AMPRI to M/s. Shubh Green Sheet Pvt Ltd, Bhilai

Feasibility studies of Tata power fly ash and to explore their use of making modular kitchen materials

Industrial inorganic waste materials for making composites have recently attracted the attention of researchers and manufactures due to the consequence of exploitation of non-renewable resources mainly coal, marble and granite and mismanagement of disposal of waste materials leading ecological imbalances and unwanted effect on health issue.

In the Tata power project, we have successfully demonstrated the application of fly ash generated from the Tata power thermal plants for manufacturing the artificial granite/marble composites for application in modular kitchen materials **(Figure 7).** We have developed a process for making the high-performance mica induced natural aesthetic and glossy finish moisture resistant artificial granite/marble composites **(Table 2)** for application in modular kitchen materials and as interior of building materails . The developed artificial granite/marble sheet were prepared using the industrial, mining and mineral waste including fly ash, marble, stone and granite particulates and glass fibres/fabric. Fabrication process describe a method for manufacturing moisture resistant fungus and termite proof with variable thickness, strengthand low thermal conductivity artificial granite/marble composites reinforced in epoxy and polyester resin in single operation mode using compression moulding system with a pressure ranging from 150 - 190 kg/ cm^2 at varying temperature of 30 - 60

°C. The specific applications of the artificial granite/marble composites are for making modular kitchen materials such as kitchen countertops/platform, partition panels, wash bowls, dressing tables, bathtubs, various count tables, wall materials, interior articles and various designer components/sheet in building, transport and construction sectors.

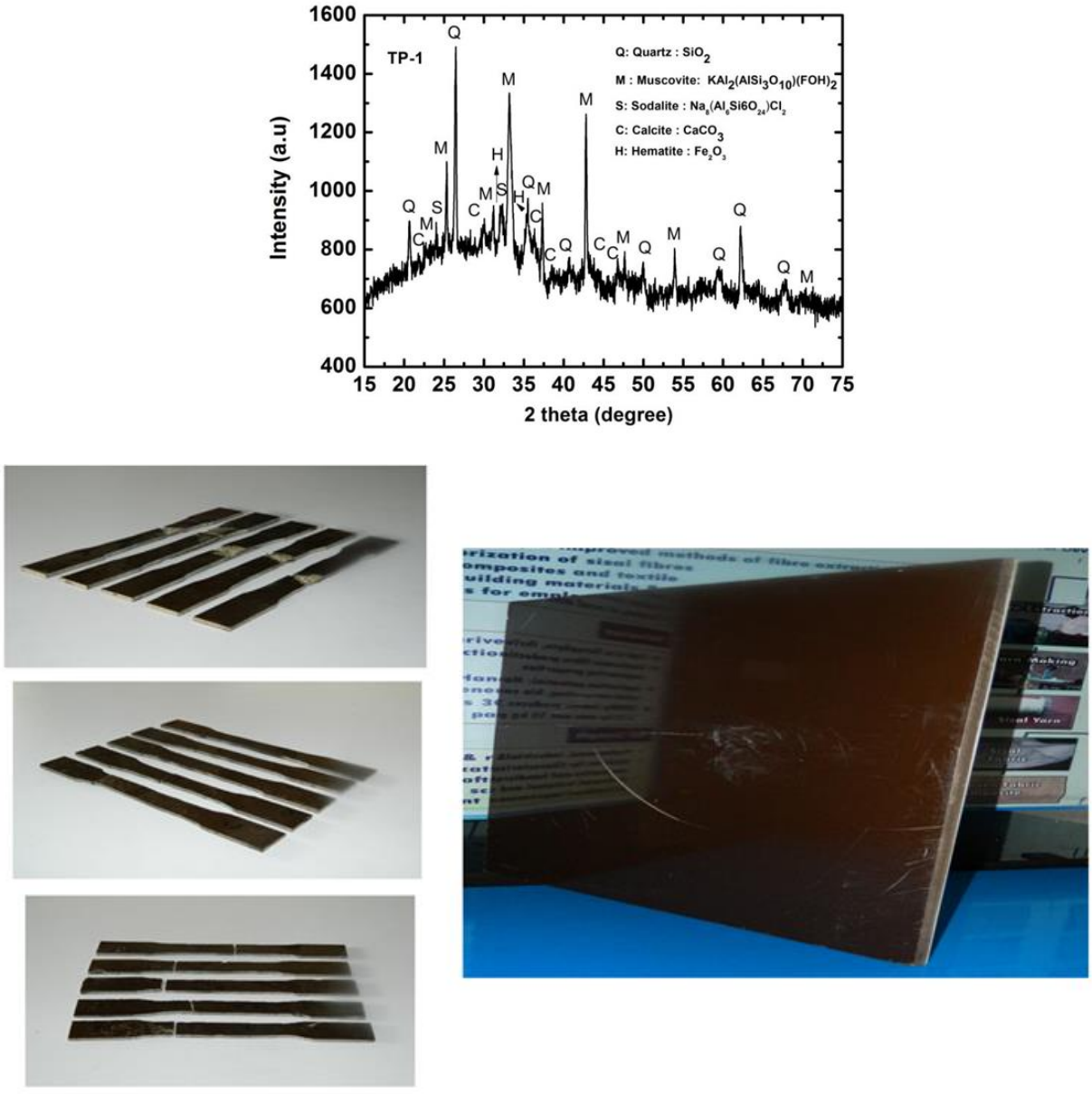


Figure 7: XRD of Tata power fly ash and artificial granite from fly ash

Table 2. Properties of the Artificial granite

Density: 1.9 g/cc to 2.4 g/cc

Water Absorption: 0.03 – 0.5 %

Thermal Conductivity: 0.21–0.72 W/mK

Tensile Strength: 19 – 55 MPa

Tensile Modulus: 5 to 7.5 GPa

Flexural Strength: 35 – 45 MPa

Flexural Modulus: 4– 6.5 GPa

Thickness Swelling: 0.2-0.30 %

Techno-Commercial Study for production of value added products from ash by product of 2G Ethanol Bio-Refinery at Bargarh, Odisha

Bharat Petroleum Corporation Limited proposes to setup "Lignocellulosic Biomass Second Generation (2G) Ethanol Bio-refinery in Odisha (Bargarh) for production of Ethanol from Rice Straw. In the Bio-refinery, the biomass is converted to Biofuels (2G Ethanol) and some by-products like CO_2,Ash and Lignin is also generated in the process.

Feasibility of the BPCL ash for making bricks, AMPRI hybrid composite panels, tiles and doors and extraction of silica as value added product were done by CSIR and contacted various industries in India as well as state of Odisha. Current scenario of fly ash uses by Bargarh brick making industries has been discussed. Major fly ash providers in Bargarh were identified. Questionnaires have been sent to various brick making and tile making stakeholders and a comprehensive list has been prepared.

The CAPEX, OPEX, IRR and NPV values have been tabulated for comparison along with the utilities requirement for silica, brick making and AMPRI hybrid composite panels, tiles and doors industries. The three (3) options recommended to BPCL are (i) silica extraction, (ii) brick making and (iii) AMPRI hybrid composite panels, tiles and doors technologies for using BPCL ash. Short term, middle term and long-term are suggested based on the current status of market potential and technical suitability of the BPCLS ash.

The agreement for buying the product back for silica extraction technology with the vendor is also suggested and recommended. We have explored with the various vendor and it is concluded that BPCL involvement (as CAPEX without OPEX and with OPEX) are required to implement the recommendation for Ash utilization as value added product **(Figure 8 and 9)** .

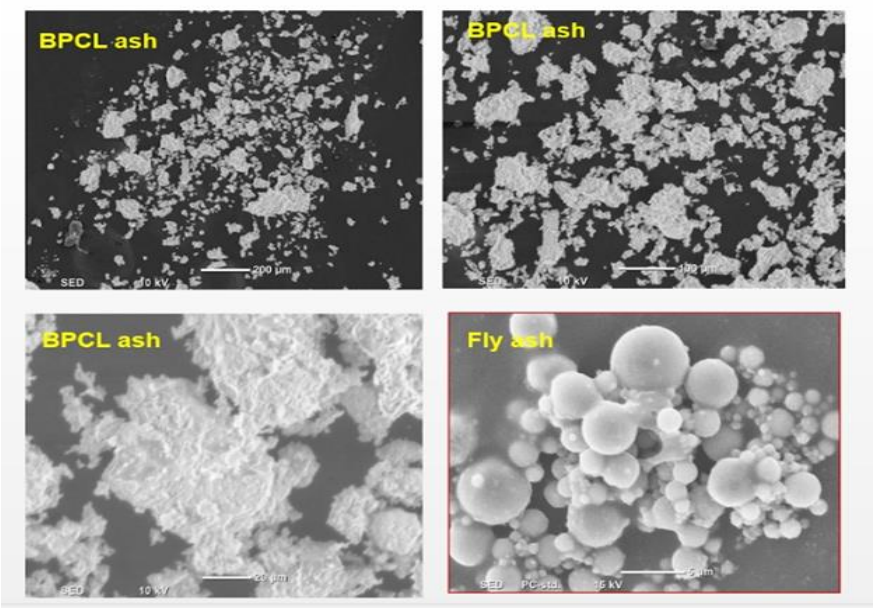


Figure 8. SEM image of BPCL fly ash generated from 2G ethenal plant

Figure 9 : AMPRI visit of BPCL, CSIR-IIP and NISTADS officials

Development of Electrical Insulating Hybrid Composite Sheet Using Industrial Inorganic Wastes

- Industrial marble and stones particulates waste sample are collected from the industrial site of Chittorgarh, Kishangarh District of Rajasthan and Madhya Pradesh state of India. Fly ash with two different chemical composition are also collected from two different thermal power plants.
- Structural and mineral analysis of the stone, marble waste and fly ash powder were performed using X-Ray Diffraction (XRD) analysis, Morphological and elemental analysis of the marble waste, stones waste and fly ash samples are done using scanning electron microscope (SEM) and EDS. WD- XRF was used to investigate the elemental analysis.
- Physical and chemical analysis of stones, marble and fly ash waste sample such as pH, conductivity density, porosity, have been investigated to fabricate electrical insulating sheet. Dielectric properties, such as dielectric constant, dissipation factor, ac conductivity were measured for inorganic industrial wastes.
- Detail particle size distribution is performed and analyzed using particle size analyser for stones, marble waste powder and fly ash sample.
- Water resistant with high strength Electrical insulating composite sheet of chemically treated stones waste powder in epoxy polymer with various filler concentration (10, 20, 40, 50 %) have been prepared using compressive moulding machine at various pressure and temperature.
- Moisture resistant electrical insulating composite sheet of chemically treated marble waste powder in epoxy polymer with various filler concentration (10, 20, 40, 50 %) have been prepared using compressive moulding machine at various pressure and temperature. Boiling Water absorption results also indicated our product as water resistant.
- High performance Electrical insulating composite sheet of fly ash powder in epoxy polymer with various filler concentration (10, 20, 40, 50 %) have been prepared using compressive moulding machine. Their detailed mechical and electrical properties are measured.
- Electrical Insulating properties such as electrical conductivity, dielectric constant, dissipation factor are measured for composite sheet fabricated using stones and marble waste powders with epoxy resin.

- Surface modification of industrial waste particulate such as stones waste, marble waste have been done using organic solvent such as ethanol and water to improve the interfacial bonding with epoxy polymer is performed .
- Electrical insulating hybrid composite based on nanoscale marble wastes are prepared using compressive molding machine and their various properties such as interfacial bonding, mechanical strength are measured .
- Dielectric Breakdown of developed marble waste with various filler concentration (10, 20, 30 and 50 %) are measured as per ASTM standard (ASTM-D-149).
- Very high value of dielectric breakdown of 15-21 kV/mm are achieved from the developed electrical insulating sheet.
- Surface and volume resistivity of developed electrical insulating sheet using marble waste with various filler concentration (10, 20, 30 and 50 %) are measured as per ASTM standard (ASTM-D-257).
- Very high surface and volume resistivity in order of 1014-1015 ohm.cm are successfully achieved from developed product.
- Temperature dependent dielectric properties, dissipation factor and ac conductivity of stones, marble and fly ash based electrical insulating products are carried out.
- Chemical test such as acid and alkaline test are performed and results are analysed.
- Leaching test was also perfromed. For leaching test, product was immerged in the DI water for 5 and 30 Days and leaching of heavy metal from electrical insulating sheet are tested using wave length dispersive X-Ray Fluorenes (WD-XRF) and results are analysed. SEM measurement was performed after acid and alkaline tests of stone based electrical insulating sheet. **(Figure 10).**

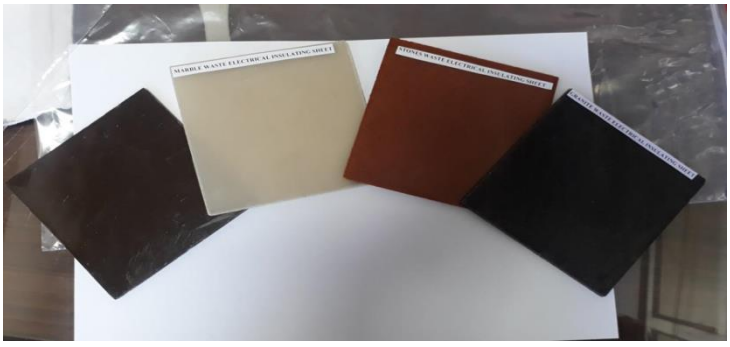


Figure 10: Electrical insulating sheet developed from marble, stone, granite and fly ash

Process for electrical insulating hybrid composite based on nanoscale marble wastes were invented using compressive moulding method and improved interfacial bonding, mechanical strength, water absorption, thermal conductivity are achieved.

Fabrication of High Performance Piezoelectric Nanogenerators

Nanogenerator (NG) is a technology that converts mechanical energy as produced by small-scale physical change into electricity. The development of new renewable electricity generation technology is immensely important to preserving the global environment and assuring sustained economic growth Piezoelectric nanogenerators has attracted great attention in last few years because of their excellent ability to convert small mechanical energy into electrical energy as vibration-based mechanical energy is the most ubiquitous and accessible energy source in the surroundings.. Using the DST-INSPIRE Faculty project, our research group has successfully develop a high-performance flexible piezoelectric microgenerator.In the project, we have successfully developed the various flexible nanogenerators based on lead free inorganic piezoelectric Na0.47K0.47Li0.06NbO3 (NKLN) microcubes based composite flexible NG, Bismuth Ferrite (BFO), Lithium Niobate (LiNbO3), Lead zirconatetitanate (PZT), Barium titanate (BT), Potassium niobate (KNbO3), ZnO, graphene, zinc silicate and piezoelectric nanoscale thin film of organic polymers like polyvinylidene fluoride (PVDF) and poly[(vinylidenefluoride] [P(VDF)] and egg –shell PVDF based high performance nanogenerators for harvesting mechanical energy from living environments. and their various properties such as dielectric constant, piezoelectric charge coefficient and ferroelectric properties have been measured.High-performance flexible piezoelectric microgenerator based on lead-free inorganic piezoelectric Na0.47K0.47Li0.06NbO3 (NKLN) microcubes for the first time. The develop flexible nanogenerator produced large piezoelectric output voltage of 48 V and output current density of 0.43 μA/cm2 and an energy conversion efficiency of about 11% has been achieved by our group.

Transparent and flexible piezoelectric lead free zinc silicate (Zn2SiO4) nanorods-graphene based nanogenerators for harvesting mechanical energies is reported for the first time. A simple and cost effective hydrothermal method was used to synthesize the piezoelectric Zn2SiO4 nanorods with non-centrosymmetricity property. Piezoelectric properties of grown Zn2SiO4 nanorods was confirmed and a piezoelectric charge coefficient (d33) of about 117 pm/V was obtained through piezoelectric force microscopy. A high performance piezoelectric hybrid composite nanogenerator was

successfully fabricated using polydimethylsiloxane (PDMS) polymer, Zn2SiO4nanorods and CVD grown monolayer graphene sheet. **(Figure 11 and 12).**

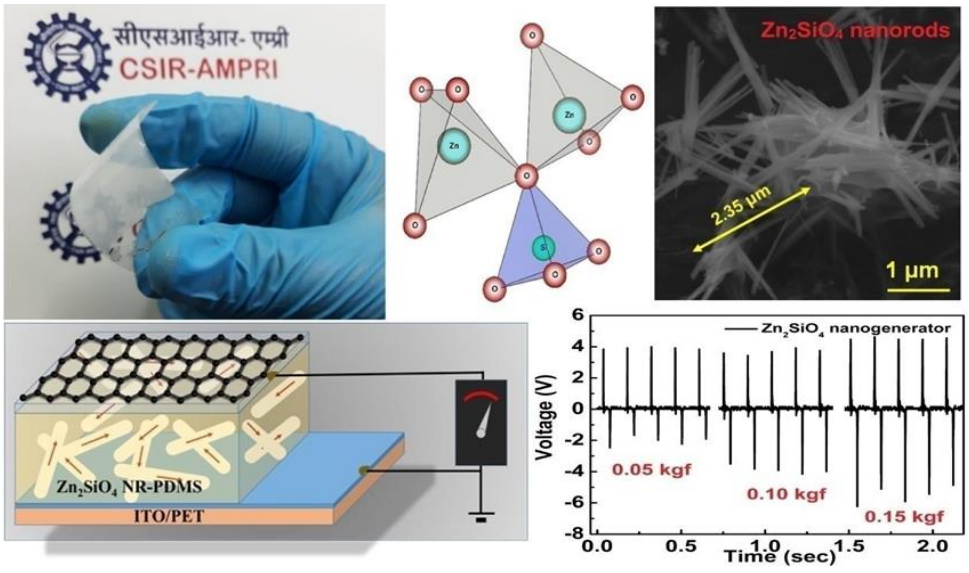


Figure 11: Schematic diagram of graphene-ZnSi2O4 piezoelectric. (b,c) The original photo of the flexible transparent ZnSi2O4- graphene-piezoelectric nanogenerator device.

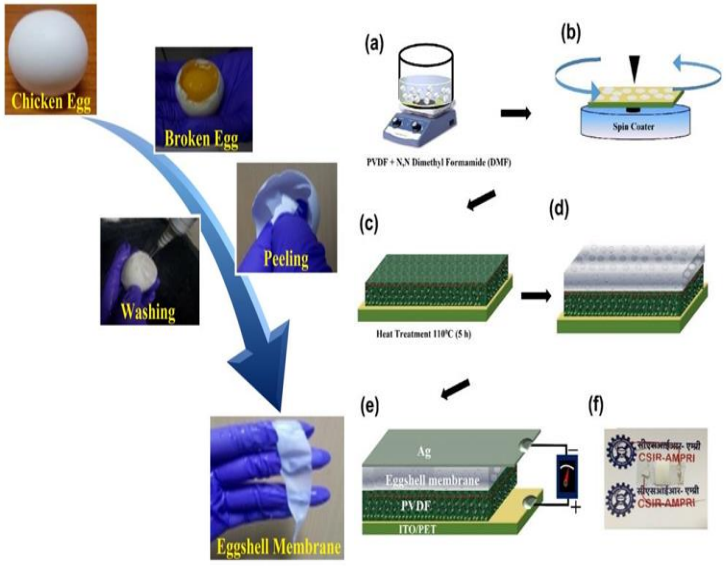


Figure 12. Schematic diagram of Extraction of Eggshell membrane from Egg Schematic for the fabrication of flexible PVDF-eggshell membrane/ based power generating device. (a) Uniform mixing PVDF with DMF (N, N-dimethylformamide) on the magnetic stirring at 150 rpm for 3 h at 90 °C reaction temperature. (b) Spin coating of PVDF on ITO coated PET. (c) Heating the PVDF thin film at 110 °C for 5 h. (d) Deposition of Eggshell membrane on the PVDF. (e) Deposition of the silver as top electrode on the hybrid structure. (f) Original image of the device.

To further improved the power output, growth of pristine vertical aligned flexible two dimensional (2D) pure ZnOnanodiscs via simple seed assisted solution route and their fabrication of piezoelectric nanogenerator was done.. Flexible piezoelectric nanogenerator was fabricated using vertical aligned ZnO nanodiscs as active piezoelectric materials and carbon nanotubes-polydimethylsiloxane (CNT: PDMS) film as top electrode. This unique 2D-type ZnO nanodiscs-based nanogenerator generated a direct current (DC) type output voltage and current density about 2.5 V and 30 nA/cm2 under compressive vertical strain, respectively. Significant enhancement of piezoelectric output voltage from a flexible nanogenerator based on a vertical aligned two-dimensional (2D) zinc oxide (ZnO) nanodiscs was achieved via thermal annealing. An output voltage and current density of 17 V and 150 nA/cm2 were detected from thermal annealed 2D ZnOnanodiscs based nanogenerators which is approximately 8 times higher (voltage) than that from the pristine nanogenerator. It is proposed that the output performance of the vertical aligned ZnOnanodiscs based nanogenerators increases due to surface passivation and reduction of oxygen vacancy. **(Figure 13 and 14)**

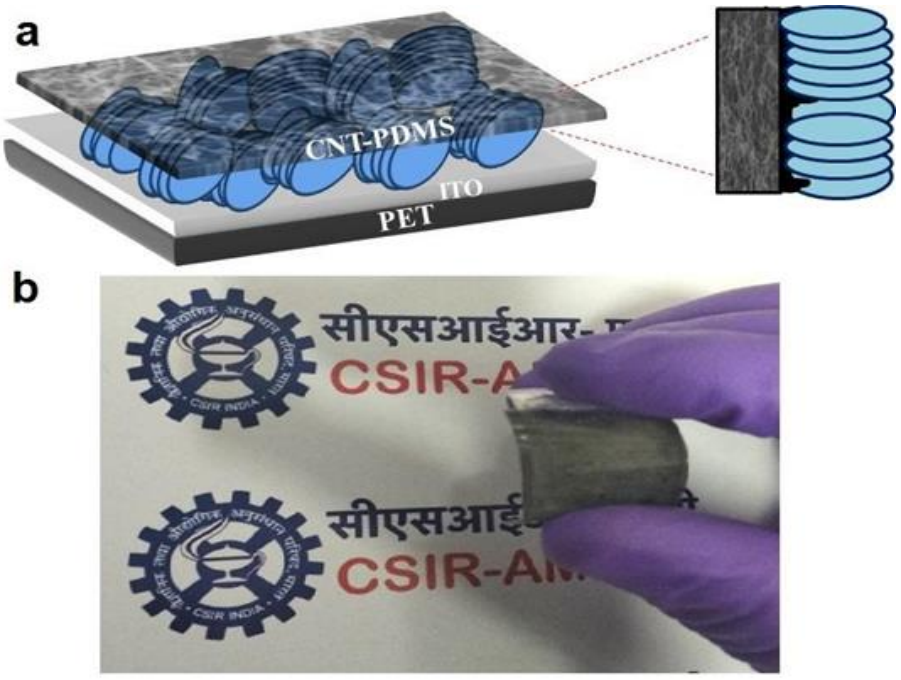


Figure 13: Piezoelectric nanogenerator based on ZnO nanodisc and CNT

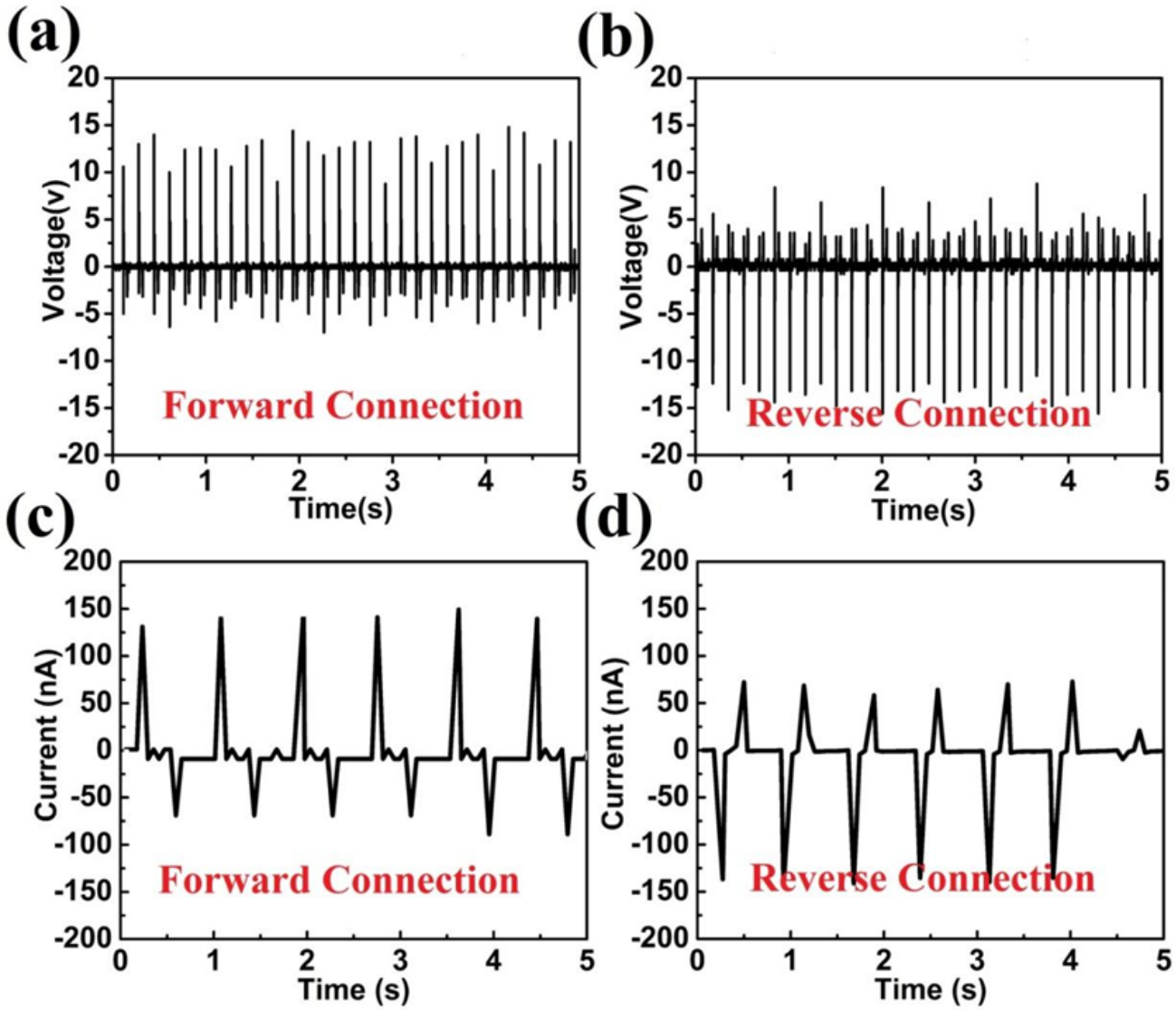


Figure 14. (a) Piezoelectric output voltage generated from the fabricated energy harvester under vertical compressive force (forward connection). (b) Output voltage under reverse connection (switching-polarity test). (c) Piezoelectric output current generated from the fabricated energy harvester under vertical compressive force (forward connection). (d) Output voltage under reverse connection (switching-polarity test).

Piezoelectric PVDF and Carbon nanotube based light weight foam was fabricated and their various properties are measured and a piezoelectric charge coefficient was measured and nanogenerator is fabricated. Light weight lead free, polymer and carbon nanotubes based flexible piezoelectric nanogenerators have prompted widespread concern for harvesting mechanical energy and powering next generation electronics devices. Self-powered Light weight polyvinylidene fluoride (PVDF)-carbon nanotube (CNT) foam was prepared to fabricate humid resistant hydrophobic flexible

piezoelectric nanogenerator for harvesting mechanical energy for the first time. Hydrophobic piezoelectric PVDF-CNT foam with density of 0.15 g/cc was prepared though solution route. PVDF-CNT foam exhibited crystalline well-defined chain like structure with 65 % fraction of β-phase. Piezoelectric coefficient (d33) of 9.4 pC/N was obtained from self-poled PVDF-CNT foam. High d33 of PVDF-CNT foam is cause by dipole alignment induced by local electric field by CNT in the microcellular structure of PVDF. The developed foam showed very high dielectric constant of 3087 at 150 Hz. Flexible piezoelectric PVDF-CNT foam based nanogenerator was fabricated, which showed high output voltage of 12 V and current of 30 nA/cm2 respectively under small vertical pressure of 0.02 kgf. Piezoelectric output performance was measured under different humid condition and an output voltage up to 9 V was observed even under 60 % RH condition. PVDF-CNT foam exhibited a hydrophobic behaviour, with a high surface water contact angle of 139o. Such high output voltage even under small pressure, without applying electrical poling and under humid condition was originated though CNT induced self-alignment of electric dipoles in PVDF polymer. These excellent performances confirmed the potential of developed foam-based device for organic based ultrasensitive self-powered nanosensors and nanosystems. **(Figure 15)**

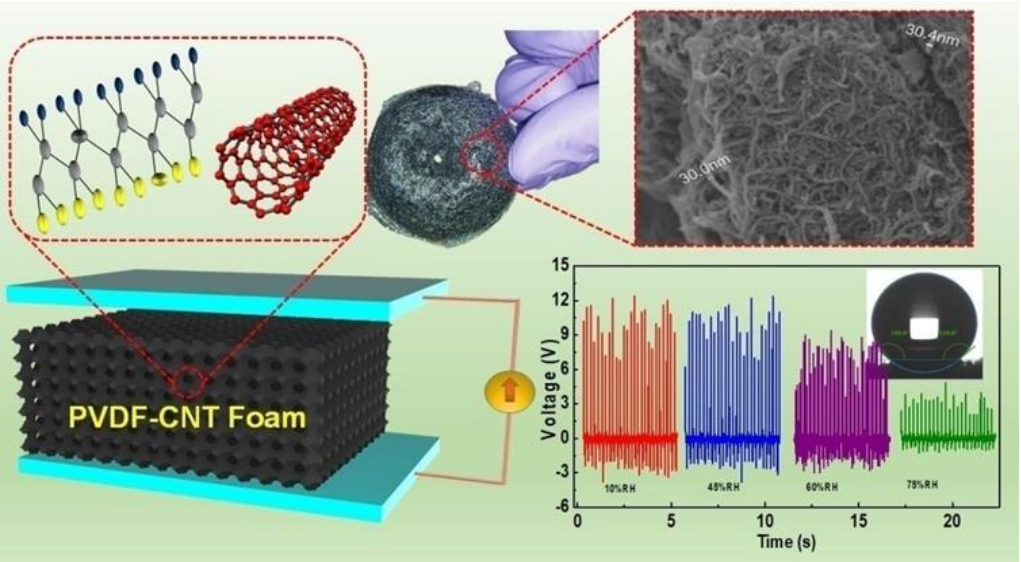


Figure 15. Self-powered Humidity Sustainable Hydrophobic Poly (vinylidene fluoride)-Carbon Nanotubes Foam Based Piezoelectric Nanogenerator

High Efficient Radiation Shielding Sheet

Recently, we have developed X-Ray Radiation shielding panels based on the red mud waste powder at low temperature fabrication process. Our division started to collaborate with the King George Medical University, Lucknow to develop low cost efficient radiation shielding panels and flexible gloves and based on the invention an international patent is filed. MoU is also signed with the KGMU, Lucknow to further accelerate the work and joint collaborative work. A collobrativ research project was also submitted to DST for funding with KGMU, Lucknow. A joint patent was filed in various country on the process of radiation shielding.

COVID-Related Activity:

E-Herbal Mask: Developed Triboelectric Generator based E-and Herbal Mask to combat the corona virus.

UV-Chamber: Developed the waste recycled hybrid composite UV chamber to disinfecting corona virus. (Figure 16)

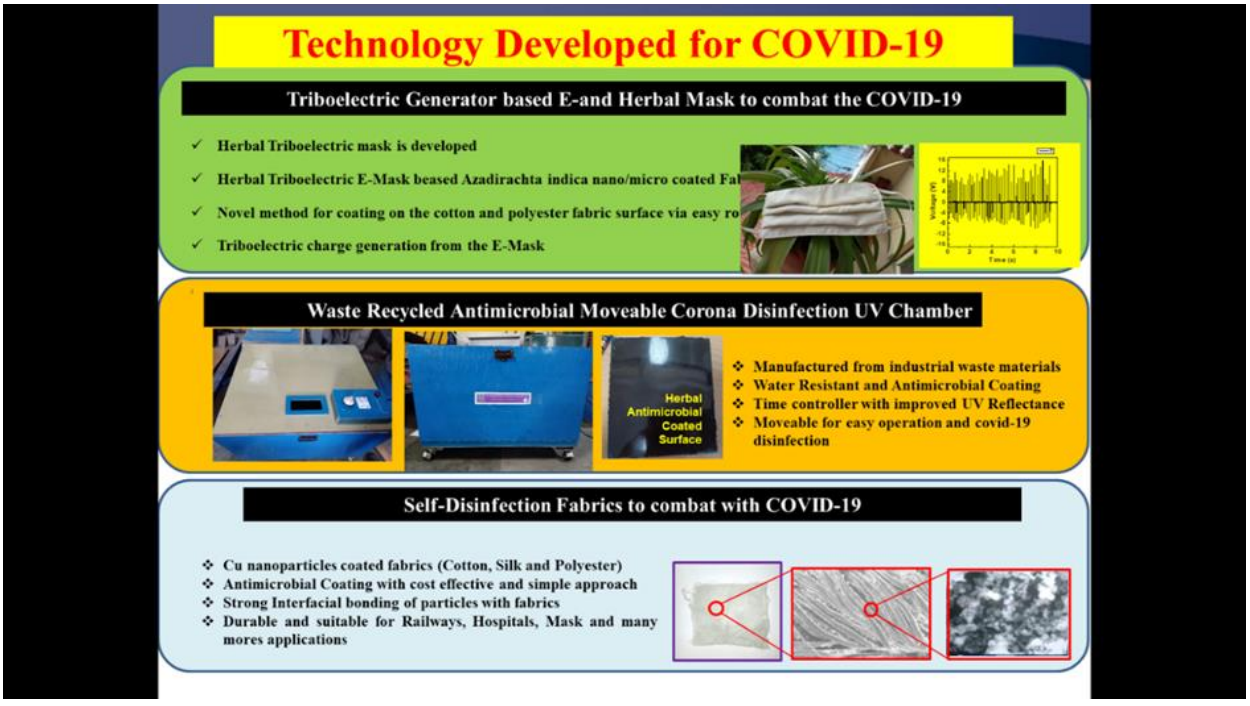


Figure 16

CSIR- AMPRI's intervention for sustainable rural development in Patalkot valley, Chhindwara district, Madhya Pradesh

CSIR-Advanced Materials and Processes Research Institute (AMPRI), Bhopal has been utilizing its scientific expertise with great passion for sustainable rural development activities in Patalkot valley. Patalkot is a deep valley around 3000 ft depth from the above surface with highly undulated topography in Tamia block of Chhindwara district of Madhya Pradesh. Here a very primitive tribe called "Bharias" lives in this valley and are totally depending on forest resources. There are 12 villages in the valley having population of around 3500 and out of twelve, four villages named Rated, Karream, Chimtipur and Charadhana having population around 2000 are adopted by CSIR-AMPRI, Bhopal for the sustainable rural development activities with the funding of CSIR - AMPRI, Bhopal and DST, New Delhi. The main objectives are to provide safe drinking water to the villagers in terms of quality and quantity and dissemination of sisal-based technology to the villagers for sustainable rural employment and income generation to stop the migration of the villagers. In Patalkot the availability of safe drinking water is a severe problem. Due to the steep slope and more runoff, the ground water aquifer recharge is very less. Even the drilling rigs can not reach up to the villages. During summer the dug wells get dry and the springs are the only sources of drinking water to the villagers. AMPRI has done a detailed hydrogeological investigation in the valley and after finding suitable sites the spring water harvesting cemented structures were constructed at hilly area and the pipe line connection has been done from the source to the villages and through gravity the water is been transported to the villages. Four community based Terafil water filters of 1000 litre capacity are installed in the villages and four gravity based nanoalumina water purification filters are installed in Rated Primary school and and in Primary and middle school of Chhimtipur village of Patalkot valley to provide safe drinking water to the children. Springs are the only main sources of the drinking water in the valley and its continuous recharge is very important for the future water availability. In this regard AMPRI has constructed 14 boulder checks, 4 gabion structures and 2 recharge pits using the surrounding resources for rain water harvesting and to recharge ground water to solve drinking water problems in Patalkot valley.

Unemployment and seasonal migration is a challenging problem among Bharia tribal in Patalkot valley. AMPRI has disseminated sisal based technology for sustainable rural employment and income generation. 30,000 sisal plantations have been done in the valley in the waste land area as a

source of sisal fiber. 60 villagers stayed in AMPRI, Bhopal and have taken five days training as a master trainer on sisal fiber extraction, processing of sisal fiber, yarn making, ropes making, handicrafts and other useful products making for employment and income generation and to stop the migration. Several trainings has been conducted in the villages also on sisal based technology, water, sanitation and hygiene for the sustainable rural development. During Covid -19, AMPRI has conducted awareness development program in the villages and distributed masks and sanitizers to the villagers in Patalkot valley as a safety measure.

Glimpses of activities carried out in Patalkot valley are shown in photogographs below

Spring water harvesting structures in for solving Installation of Nano alumina water filter in drinking water Rated village of Patalkot Valley

Installation of Nano alumina water filter in drinking water Rated village of Patalkot Valley the Chatravas of Chimtipur village, Patalkot

Sisal plantation for the source of sisal fiber in Karеam village of Patalkot valley

Training to the villagers at AMPRI on Sisal based technology for rural employment generation

Training on Sisal fiber yarn making technology at AMPRI for rural employment generation

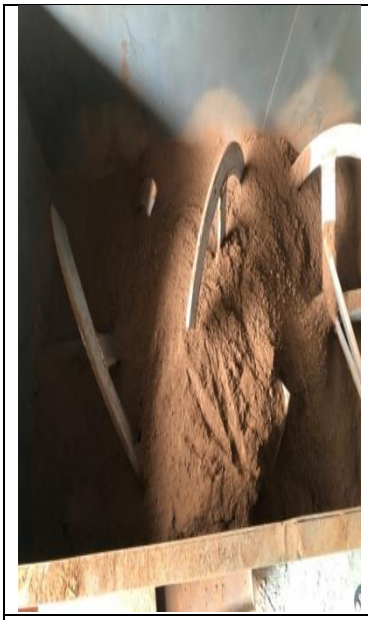
Training in Charadhana on Sisal fiber handicrafts for rural employment generation making for rural employment generation

Centre for Advanced Radiation Shielding & Geopolymeric Materials

Up Scaling of technology for making advanced non-toxic radiation shielding materials of strategic importance, utilizing industrial wastes

The increased power consumption and demand for nuclear power in India has compelled the Government to commission New Nuclear reactors in different parts of the country, hence this has increased the requirement of shielding aggregates manifolds .

The CSIR-Advanced Materials and Processes Research Institute (AMPRI), Bhopal has developed a process for development of Radiation Shielding Synthetic Aggregate utilizing Aluminum industry waste Red Mud**. (Photograph below**)

		
Red Mud + Additives Blending	**Pallatizing**	**Oven Drying on Up-Scaled Level**

		
Up-Scaled Heat Treatment	**Heat Treated Product**	**Red Mud based Heavy Density Synthetic Aggregate**
		
Mix Design of Heavy Concrete	**Slump Cone Test**	**Heavy Concrete Sample Cube & Slabs**
		
Heavy Concrete Beam & Cylinder Samples	**Curing of Sample Cuble**	**Compressive Strength Testing**

		
Flexural Strength Testing of Hevy Concrete	**Heavy Concrete Saple Slabes**	**Testing of Heavy Concrete at BARC, Mumbai**

Significant S&T Achievements

- The development of Heavy density Radiation Shielding Synthetic Aggregate utilizing Aluminium industry waste Red Mud.
- Advanced "Chemically formulated and Minerlogically designed - multi-component- multi phases containing" Synthetic heavy density radiation shielding aggregates were developed by ceramic processing of industrial waste Red Mud with additives.
- The developed aggregates on the up-scaled level were tested for engineering properties and are found superior compared to hematite ore aggregate.
- The reference radiation shielding concrete was developed using conventional Hematite Ore aggregate with cement as well as fly- ash-based Geopolymeric matrix.

Testing for Engineering Properties at CSIR-AMPRI Bhopal:

- The maximum 28 days Compressive Strength of Cement Concrete using Hematite Ore Aggregate is found to be 38.9 MPa, whereas 28 days compressive strength of cement-based Concrete using Red Mud based Synthetic Aggregate is found to be 52.9 MPa.

- The maximum 28 days flexural Strength of Cement Concrete using Hematite Ore Aggregate is found to be 4.2 MPa, whereas 28 days compressive strength of cement-based Concrete using Red Mud based Synthetic Aggregate is found to be 5.2 MPa.
- The maximum 28 days Compressive Strength of Fly Ash based Geopolymer Concrete using Hematite Ore Aggregate is found to be 32.2 MPa, whereas 28 days compressive strength of fly Ash based Geopolymer Concrete using Red Mud based Synthetic Aggregate is found to be 54.1 MPa.
- The maximum 28 days flexural Strength of Fly Ash based Geopolymer Concrete using Hematite Ore Aggregate is found to be 3.5 MPa, whereas 28 days Flexural strength of fly Ash based Geopolymer Concrete using Red Mud based Synthetic Aggregate is found to be 5.2 MPa.

Testing for Radiation Attenuation Properties at DAE- BARC Mumbai :

- Reference Cement Concrete using hamatite ore aggregate, Red Mud Based Synthetic aggregate and Geopolymer concrete using Hematite ore aggregate and Red Mud based Synthetic aggregate are developed and slabs of size 30cmX30cmX7.2cm were cast and transported to Mumbai & tested at **Radiation Safety Systems Division,** Radiation Standards Section, Bhabha Atomic Research Centre (BARC), Mumbai for Radiation Shielding attenuation properties using high energy Gamma Source **^{137}Cs. & ^{60}Co**
- The developed radiation shielding **Cement concrete** achieved an attenuation factor of 5.73 as compared to the 5.01 attenuation factor for reference hematite ore based cement concrete using**^{137}Cs.**
- The developed radiation shielding **Cement concrete** achieved an attenuation factor of 4.07 as compared to a 3.73 attenuation factor for reference hematite ore concrete using **^{60}Co**.
- The developed novel design mix **Geopolymer concrete** achieved an attenuation factor of 5.68 as compared to 5.03 attenuation factor for reference hematite ore concrete using **^{137}Cs.**
- The developed novel design mix **Geopolymer concrete** achieved an attenuation factor of 4.29 as compared to 3.85 attenuation factor for reference hematite ore concrete using **^{60}Co.**
- The developed Red Mud based Synthetic Aggregate **Cement concrete** achieved around 10 to 12% higher attenuation for high-energy Gamma radiation source, i.e. **^{137}Cs.** compared to conventional hematite ore-based Cement concrete & 8-10 % higher attenuation for high

energy Gamma radiation source i.e. **^{60}Co.** as compared to conventional hematite ore based Cement concrete

- The developed Red Mud based Synthetic Aggregate based Fly **Ash matrix Geopolymer concrete** achieved around 9 to 11% higher attenuation for high energy Gamma radiation source, i.e., **^{137}Cs.** Compared to conventional hematite ore based **Fly Ash matrix Geopolymer concrete** & 8-10 % higher attenuation for high energy Gamma radiation source i.e. **^{60}Co.** as compared to conventional hematite ore based Fly Ash matrix Geopolymer concrete

Conclusions

- The developed red Mud based synthesis shielding aggregate are found capable to replace conventionally used hematite ore aggregate for making heavy density radiation shielding cement concrete and radiation shielding Geopolymeric Concrete applicable for construction of nuclear power plants and medical diagnostic centres.
- Bulk utilisation of aluminium industry waste red for making synthetic shielding aggregate will help in conserving non-replenish able hematite ore natural aggregate required in making conventional radiation shielding concrete.
- Under the CSIR component a Centre for Advanced Radiation Shielding and Geopolymeric Materials have been established at CSIR- AMPRI Bhopal.

Establishment of Centre for Advanced Radiation Shielding and Geopolymeric Materials (Under DST-CSIR Projects)

Genesis :

It was more than a decade ago when CSIR –AMPRI started work on Research and development in the field of Radiation shielding Materials and Geopolymeric materials simultaneously. The materials were developed for X-Ray, Gamma and Neutron radiation shielding with application in various sectors ranging from X-Ray & Medical diagnostic centre to Nuclear Power plants. A novel process for making lead free and highly effective shielding materials useful for the construction of X-ray diagnostic and CT scanner room has been developed utilizing industrial waste namely red mud and fly ash.

In the Year 2008 CSIR-AMPRI demonstrated X-Ray Radiation Shielding Tiles at J.P. Hospital Bhopal & AMPRI developed low temperature novel process for making Radiopac materials utilizing industrial wastes as raw materials, has been granted US patent - US 7,524,452 B2. (2009). The X-Ray Shielding Material developed by CSIR-AMPRI Bhopal has been accredited by Atomic Energy Regulatory Board (AERB) Mumbai

During the Year 2012-15 successfully completed BRNS funded Project entitled Development of Design mix for making irradiation shielding concrete using advanced shielding materials, During Year 2016-2020 a DST-CSIR prestigious project on Up- Scaling of technology for making Advanced Non - Toxic Radiation Shielding Materials of Strategic Importance, utilizing Industrial wastes has been successfully completed

The Geopolymeric Materials were developed utilizing Coal based Thermal Power Plant waste i.e. Fly-Ash through a wider spectrum potential in the form of geo-polymeric approach for infrastructural applications. CSIR-AMPRI has developed and demonstrated Geopolymeric Concrete Road Stretch in the AMPRI Premises in the Year 2014 and With improved geopolymeric technology with solid ingredients has been demonstrated at AIIMS Bhopal in the Year 2017 and granted three US Patent on geopolymeric materials. An Ongoing CSIR funded Facility Creation Project on Up-Scaling of Advanced Solid form Geopolymeric Concrete for Road Applications is in progress

With the continual development a unique Centre for Advanced Radiation Shielding and Geopolymeric Materials with Total Area 455.52 Sq.m and Carpet Area 906.24 Sq.m is being established by CSIR-AMPRI Bhopal

The above Centre has been inaugurated by Honorable Dr. Harsh Vadhan, Minister of Science &Technology & Vice President CSIR on 13th March 2021. (Photograph below)

Inauguration of Centre for Advanced Radiation Shielding& Geopolymeric Materials (CARS&GM) by Honorable Dr. Harsh Vadhan, Minister of Science &Technology & Vice President CSIR on 13th March 2021

Perspective Research and Development at Centre

- Research & Development on Radiation Shielding and Geopolymeric Materials for advancing the Technology and Science to make the Centre of Excellence in the Area
- Filling up Science and Technology Gap and Enhancing the knowledge for understand the mechanism of Radiation Shielding and improvement in Engineering Properties of developed materials
- Upscaling of Technologies in the area of Radiation Shielding & Geopolymeric Materials for extending Technological Support to Indian Industry

Advances in Radiation Shielding Materials

- Establishment of Modern Characterization facilities such as TEM, XRF, SEM etc.
- Development of Non Toxic (Lead Free) Radiation Shielding materials
- Development of shielding materials for simultaneous Gamma and Neutron Radiation attenuation
- Development of Light Weight Radiation Shielding Materials
- Development of Graphene Induced Radiation Shielding Materials

Advances in Geopolymeric Materials :

Strategic Applications:

- Development of Thermal Resistant Geopolymeric Concrete for Missile /Rocket Launching Pad
- Development of Geopolymeric Bullet Proof Concrete for Bunkers
- Development of Graphene Induced Geopolymeric Concrete
- Development of Geopolymeric Radiation Shielding Concrete

Advanced Conventional Applications:

- Up-Scaling of Solid Form Geopolymeric Binder
- Development & Up Scaling of Ready Mix Geopolymeric Concrete road applications
- Development of Geopolymeric Concrete for Structural Applications
- Development of Roller Compacted Geopolymeric Concrete
- Development of Pre-Stressed Geopolymeric Concrete components such as Railway Sleepers

Above R &D Activities may be achieved through :

- External R& D Funded Projects
- Human resource & funding from CSIR
- M.Tech & Ph.D Research Work

Beneficiaries / Funding Organization :

- Department of Atomic Energy (BARC, BRNS, NPCIL & AERB)
- Thermal Power Plants (Public Sector & Privet Ltd)
- National Highway Authority of India (NHAI)
- Central Public Works Department (CPWD)
- Rural Road Development Organizations

- Border Road Organization
- Medical Diagnostic Centres
- Smart City Development Corporation Limited
- Airport Authority of India
- Academic Organizations
- Ministry of Road Transport & Highways (MoRTH)
- Ministry of Environment and Forest & Climate Change (MoEF&CC)
- Ministry of Railways
- Indian Space Research Organization (ISRO)
- Defence Research and Development Organization (DRDO)

Green Engineered Materials and Additive Manufacturing

Bamboo-composite development

CSIR-AMPRI, Bhopal has been working on the design and development of high-end value-added products utilizing naturally available resource bamboo. CSIR-AMPRI has developed the Knowhow of making "Bamboo Composites for Modern Housing and Structures" in the last completed FTT project (MLP-0119, 2018-2020) and has already transferred this Knowhow Technology to M/s Permali Wallace Pvt. Limited, Bhopal, in February 2020. Designing and development of bamboo composite structural element of larger sizes, suitable for the construction industry is the main objective of this project. The procurement of desired bamboo species, the initial processing, conversion of these bamboos into fibrous form, and their chemical treatment has been done. The process for development of bamboo composite beams (with and without joints) of different lengths & cross sections have been developed and are characterized for different properties **(Figure 1).**

Figure 1 : **Bamboo composite material with and without joints/ confinement**

Flexural tests were performed on these bamboo composite materials (BMC) without joints as per standard procedure. **Figure 2(a)** shows the performance of bamboo composite material without joints and effect of confinement on its flexural behavior. An increase of 40% in strength and 15 % increase in ductility was found due the confinement in BCM without joints.

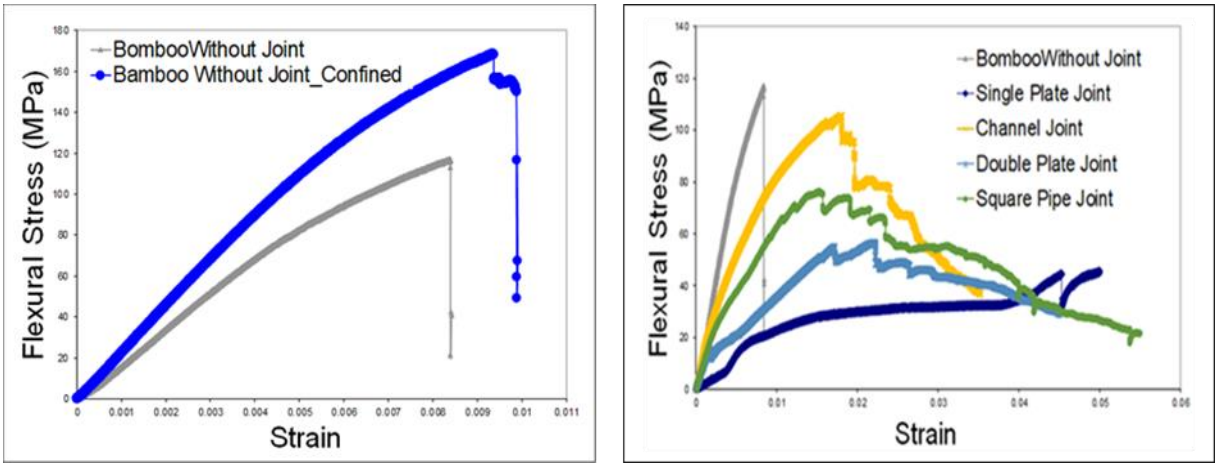


Figure 2: (a) Effect of confinement on flexural behaviour of bamboo composite material (BMC) and (b) Flexural performance of Bamboo composite material without and with four types of joints (Un-confined Case)

Flexural tests were also performed on BCM with joints (single plate joint, double plate joint, channel joint and square pipe joint) and compared with performance of BCM without joints as shown in **Figure 2(b).** Comparing the flexural performance, it was found that channel joint performs almost similar to that of BMC without joint. The results of the proposed investigation will be useful for exploiting the usage of these bamboo composite materials for use in construction industry.

The construction of a Demo Bamboo Hut "Baithak" at CSIR-AMPRI, Bhopal is also under progress. For the dissemination of the knowledge/ knowhow technology, discussions with our industrial partner M/s Permali Wallace Ltd, MPSBM have been undertaken and two workshops on "Bamboo and Bamboo Wood for Industrial and Domestic Applications" were also organised at Agartala, Tripura and Shillong, Meghalaya.

Development of carbon-based very hard and super-elastic coatings

CSIR-AMPRI, Bhopal has developed very hard and superelastic coatings, based on nitrogen incorporated diamond-like carbon, by employing novel cost-effective plasma tool operating in low vacuum condition **(Figure 3),** which is desirable for enhanced commercial applications. The coatings were thoroughly characterized by SEM, AFM, optical, mechanical and electrical properties. These very hard, superelastic and wear resistance coatings are crucial for engineering, biomedical, automobile and aerospace applications.

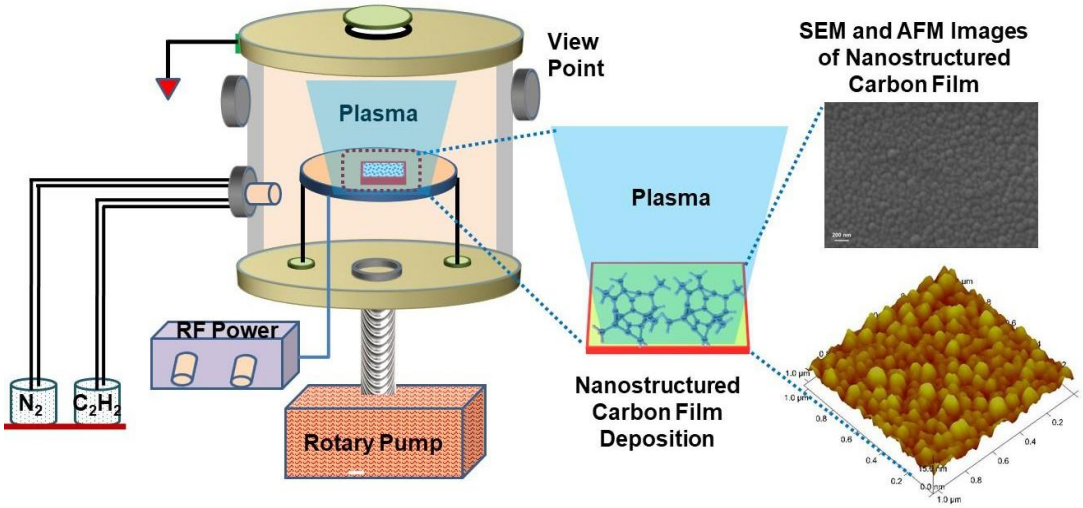


Figure 3: Carbon-based very hard and super elastic film (wear resistant film) produced by plasma process.

Properties and prospects on graphene-based materials to combat COVID-19

CSIR-AMPRI Bhopal is actively working on design and the development of graphene-based materials for diverse applications. Since graphene-based materials display many exciting properties, we proposed how these properties can enable the development of diverse practical components/systems required for combating COVID-19, as shown in **Figure 4**.

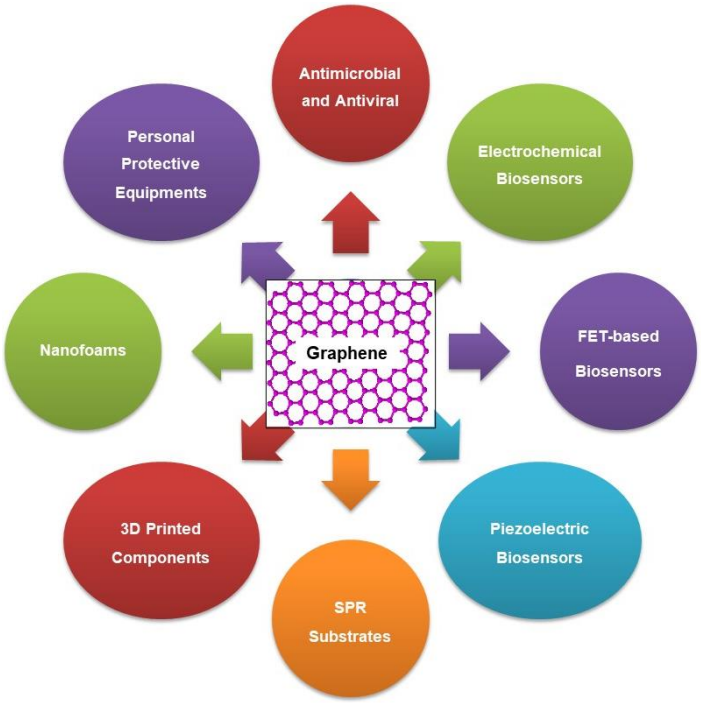


Figure 4: Graphene for development of diverse components that are required to combat COVID-19.

Development of bilayer graphene by RTP-CVD

The bilayer graphene is noteworthy for many multi-functional devices due to its tremendous properties. In recent years, twisted bilayer graphene (tBLG) has been studied widely due to its interesting magnetic and transport properties revealed due to the magic angle. Understanding the mechanism and the growth of bilayer graphene by modifying the seeds and chemical kinetics is essential for developing devices. Herein, the bilayer graphene growth on copper foil by Rapid Thermal Processing Chemical Vapor Deposition (RTP-CVD) has been examined. The four deconvoluted Lorentzian peaks of the 2D band of bilayer graphene are shown in **Figure 5.**

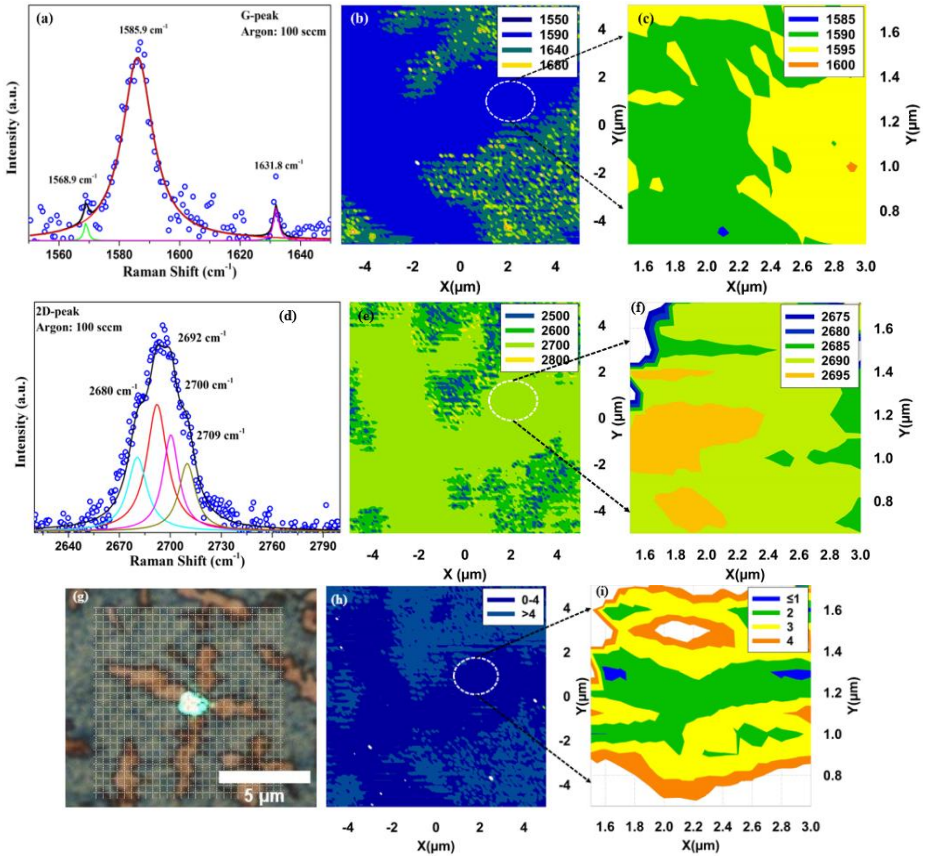


Figure 5: (a) deconvoluted G-peak. (b) The 2D plot of ω_G mapping and (c) zoomed 2D plot (X: 1.6 to 3.0 μm and Y: 0.65 to 1.72 μm). (d) deconvoluted 2D-peak. (b) The 2D plot of ω_{2D} mapping and (c) zoomed 2D plot (X: 1.6 to 3.0 μm and Y: 0.65 to 1.72 μm). (g) optical microscopic image with Raman mapped area (11 μm x 11 μm). The 2D plots (h) and (i) correspond to the I_{2D}/I_G ratio. Mapped 2D plots are at 100 SCCM argon concentration.

2D Materials for hydrogen storage

CSIR-AMPRI Bhopal is working on developing graphene-based materials for hydrogen storage. In one of the works, AMPRI scientists have demonstrated the storage of hydrogen in graphene oxide, as shown in **Figure 6.**

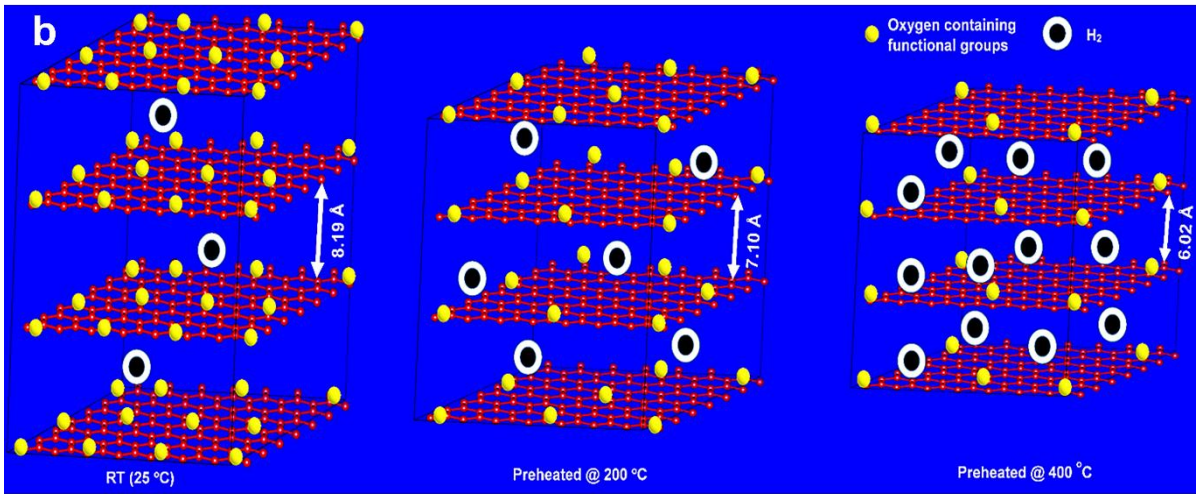


Figure 6: Hydrogen storage in preheated graphene oxide at room temperature.

Water Resource Management & Rural Technology Division

Development and Demonstration of Makeshift Hospital / Clinic / Housing Technology for Immediate Preparedness during COVID - 19 outbreak / Post Disaster Rehabilitation

With increasing number of Covid-19 patients across the country and clusters in cities, the spread of pandemic is leading to stress the healthcare services. For Covid-19 patients, isolated hospital bed is needed whereas all such probable patients are needed to be quarantined at different centre for weeks. In view of increasing Covid-19 patients, there is a dire need to increase our health care infrastructure by speeding up the construction of hospitals. However, construction of full-fledged hospital may not be feasible in short span of time. Accordingly, for immediate and short term relief, the proposed technology of 'makeshift hospitals / housing may be utilized at large scale for erecting single or connected units of structures for setting up temporary hospitals, check-up camps and quarantine facility.

Makeshift hospital / housing technology is a remarkable research development for immediate preparedness in event of pandemic outbreak / post disaster rehabilitation. The technology for 'makeshift hospitals/housing' can be utilized at large scale for erecting single or connected units of structures for setting up temporary hospitals, check-up camps and quarantine facility.

The technology for makeshift hospital/clinic/housing has been developed jointly by CSIR-Central Building Research Institute, Roorkee and CSIR-Advanced Materials and Processes Research Institute, Bhopal. Both the institutions have legacy of serving the nation through technological interventions for decades.

With this technology, structures can be erected with prefabricated steel portals having features like foldable, easily erectable, reusable, safe, serviceable, comfort to the occupants and cost-effectiveness. It can be optimised for space utilisation, scalable and appealing aesthetics. The structures can be erected by semi-skilled manpower and hence provides opportunities for employment generation also. This technology can be scaled up for constructing makeshift hospital wings, clinic or isolation centre amid the Covid-19 pandemic. Further, the technology will be useful in other spheres also wherever makeshift buildings are needed like pulse polio camps, blood donation camps and areas affected by natural calamities like flood, earthquake etc.

Features of Makeshift Clinic/housing Technology

- Metallic portal framed foldable, lightweight & durable structure.
- Fast to erect, Single story.
- Composite Panels based Partition.
- Prefabricated metallic portals having features like foldable, easily erectable, reusable, safe, serviceable, comfort to the occupants.
- Offers immediate solution to the current crises of COVID-19/other crises by number of makeshift hospitals, clinics, disaster relief camps, blood donation camps, pulse polio derives, earthquake, flood prone areas, seminar / conference/exhibition room etc.
- Possesses water, wind and fire resistance capabilities.
- Easy to transport from one place to other.
- Cost effective and reusable for other purposes.

Fabrication and erection of Makeshift Clinic:

CSIR-AMPRI Bhopal identified J P Govt. Hospital, Bhopal as suitable site in consultation with M. P. Council of Science and Technology for erection and demonstration of the makeshift housing technology.

Makeshift clinic was erected at the site adjacent to AYUSH wing of the hospital using prefabricated material comprising of foldable and reusable portals, sheeting material in 5 days which can be further reduced during up scaling. Typical elevation and photographs of the erected clinic of the makeshift structure is shown in photos below. The erected structure with 600 sqft plan area is internally partitioned to cater to the needs of a regular clinic. It comprises of sitting/waiting area, dressing section, doctor's chamber, check-up section and pharmacy area. The plan of the erected structure is attached in annexure II. The erection work of makeshift clinic was completed by M/s J T Events, Bhopal. **(Figure 1-5)**

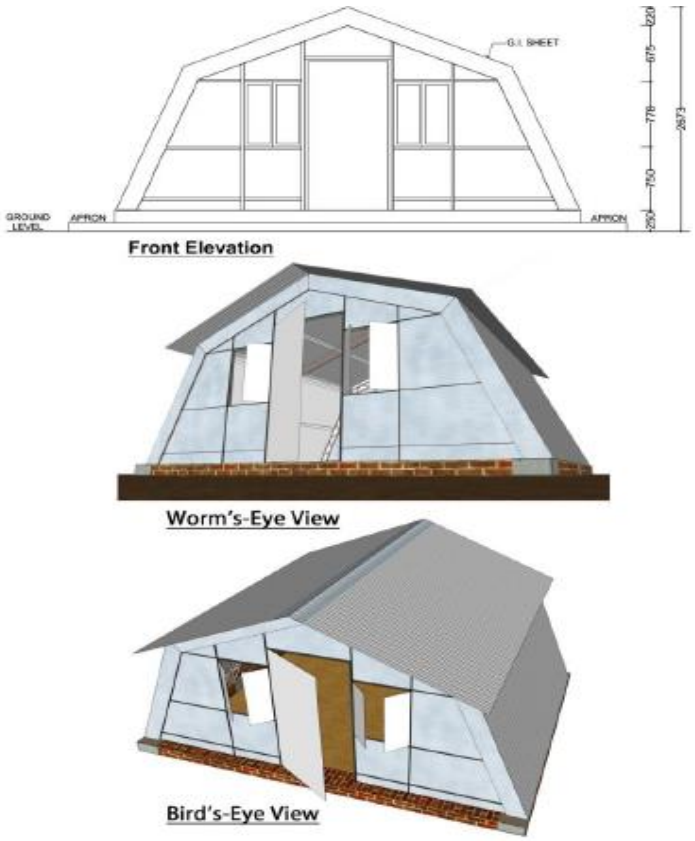


Figure 1: Artistic view of the makeshift housing/clinic

Figure 2: Erection of Makeshift Clinic under progress

Figure 3: Inspection of erected Makeshift Clinic

Figure 4: Completed Makeshift Clinic

Figure 5: Operational Makeshift Clinic/fever Clinic

Development of 3D printer for additive construction of scaled model of building and construction material optimization

Construction Industry accounts for around 6% of world GDP which is expected to grow manifold in next decade due to increased urbanization. However, the construction process is still largely dependent of traditional knowledge and established work procedure with focused mechanization of individual activities. 4th Industrial revolution with respect to construction sector termed as Construction 4.0 will transform construction industry. Construction 4.0 is largely technological intervention for automation of whole construction approach by 3D printing structures by virtue of additive manufacturing and their life cycle assessment saving energy, achieving speed and quality of construction. Additive Manufacturing (AM) is an appropriate name to describe the technologies that build 3D objects by adding layer-upon-layer of material, whether the material is plastic, metal, concrete. Mortar and concrete are primary construction materials. This project is focused to develop 3D printer for additive construction of room/building in a scaled down model/segments with optimized mix of mortar/concrete.

3D printers provide us freedom to address complexities of designs, shapes and give freedom to architects along with speed and quality of construction. Mortar and concrete are primary construction materials which can be extruded through specifically designed nozzle attached with robotic arm or 3D printer of adequate size and adequate degree of freedoms to construct houses/buildings in layer by layer manner. The mechanization of construction process will ensure speed and quality in the constructed infrastructure and have potential to revolutionize the construction industry. Following **Figure 6** shows different components of holistic additive construction.

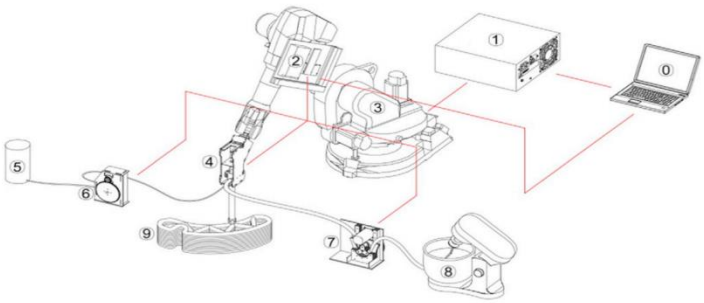


Figure 6: Schematic of the 3D printing setup: 0. System command; 1. Robot controller; 2. Printing controller; 3. Robotic arm; 4. Print head; 5. Accelerating agent; 6. Peristaltic pump for accelerating agent; 7. Peristaltic pump for premix; 8. Mixer; 9. 3D printed object (Gosselin et al. 2016)

During the FY 2020-21, procurement of equipment like progressive cavity pump, along with other smaller equipment like vibration table, vee bee consistometer, flow table, slump cone and consumables like polypropylene fibres, steel fibres, admixtures, SAP, cement, sand etc. have been completed etc. **(Figure 7-9)**

Figure 7: Progressive Cavity pump with mixer

Figure 8: Vibration table and Vicat apparatus

Figure 9: Flow table and slump cone

Water Table depletion study in and around Sanjay Gandhi Thermal Power Station, Birsinghpur, Madhya Pradesh along with rain water harvesting to recharge water for the ground water enrichment

Objectives:

- To understand and evaluate water resources usage, potential and development of the area.
- To develop databases for dynamic behaviour understanding of water resources regime.
- Water table depletion study in and around the project area of Sanjay Gandhi Thermal Power Station.
- To identify suitable sites and structure for water harvesting to recharge groundwater.

Work Plan:

- Delineation of the study area
- Conducting preliminary field survey hydrogeological and geological conditions
- Generation of thematic maps for land use / land cover, lithology, drainage slope, geomorphology etc. through remote sensing data and field visit.
- Estimation of water requirements, groundwater withdrawals through field survey and experiments.
- Development of water requirements, groundwater withdrawals through field survey experiments.

- Development of water resources management plan in accordance with the requirement and availability along with technical specification and methodology for groundwater recharge.(**Figure 10)**

Figure 10: Sanjay Gandhi Thermal Power Station, Birsinghpur (Area 8.60 Sqkm)

Water Depletion study in and around the project of Shri Singaji Thermal Power Project, Dongalia, District Khandwa M.P. alongwith rainwater harvesting to recharge water for the ground water enrichment

Objectives:

- To understand and evaluate water resources usage, potential and development of the area.
- To develop databases for dynamic behaviour understanding of water resources regime.
- Water table depletion study in and around the project area of SSTPP Dongalia, Distt., Khandwa.
- To identify suitable sites and structure for water harvesting to recharge groundwater.

Work Plan:

- Delineation of the study area.
- Conducting preliminary field survey hydrogeological and geological conditions.
- Generation of thematic maps for land use/land cover, lithology, drainage, slope, geomorphology etc. through remote sensing data and field visits.
- Collection of secondary data related to hydrogeomorphology, groundwater etc.
- Estimation of water requirements, groundwater withdrawals through field survey and experiments.

❖ Development of water resources management plan in accordance with the requirement and availability along with technical specification and methodology for groundwater recharge**.** **(Figure 11)**

Figure 11: Shri Singaji Thermal Power Project (Area 10.3 sqkm)

Important Technological Contributions

Aluminium-SiC Composites for automobile and engineering applications

A series of aluminium alloys based composite materials have been synthesized and characterised in detailed. The automatic set up for making aluminium composites at a scale of 100 kg/day has been established. The composite materials exhibited yield strength of 200 to 220 MPa and UTS of 275 to 300 MPa when the base alloy is an Al-Si alloy. But with 5083 based Al-SiC composite materials exhibited yield strength of 200 MPa after casting. After forging and heat treatment the composite exhibited yield strength of 475 MPa and UTS of 600 MPa. This make these materials suitable for following applications: Brake drums, brake discs, cylinder liner, connecting rods, wheels and light weight manhole cover. CSIR-AMPRI, have successfully made the composites in pilot scale and the same has been forged. The manhole cover of size 450 mm x450 mm x25 mm has successfully be cast and tested. It carries 50Ton load without any failure. Similarly, brakedrums for four wheeler have also successfully been made as per its dimensional accuracy of 0.01 mm. The weight of these components is reduced by 1/3rd the weight of conventional components and the cost of the components are slightly cheaper than cast iron components.

Evergreen hybrid composite of Parali-Agro waste and industrial waste

The process knows- how for manufacturing hybrid composite materials have been licensed to one industries d Chhattisgarh on non-exclusive basis to to M/s Shubh Green Sheets Private Limited, Bhilai, Chhattisgarh. The technology "Evergreen Hybrid Composite of Parali-Agro-waste and industrial wastes developed under CSIR- FTC (MLP-115) programme deals with use of paddy straw. As part of the technology licensing, training was provided to entrepreneurs and industries at CSIR-AMPRI Bhopal. All possible efforts are being made for commercial exploitation of the hybrid composite products and creating another 20 industries in India.

Business plan to be executed through following steps:

- Exploring with Industries
- Organising industry meet
- Participation & showcasing of hybrid composites

Further, to take these research findings to industry, entrepreneurs and start-ups for creating awareness and confidence for commercialization another six months are required.

To ease commercialisation of existing technologies and creating funding and ECF, the following business plan have been envisaged:

- Make concrete efforts to provide solutions to industrial demand and necessity to meet their immediate needs

- Make better negotiation with industry clients for technology pricing and technology transfer on mutually acceptable conditions.

- Undertake turnkey project for creation & setting up new industry for manufacturing hybrid green composites technology.

- Technology dissemination on robastic approach and create awareness and confidence on developed technology and attract entrepreneurs and startups for commercialization

New linkages and networking has been made with several agencies / public sectorsand major industries such as Tata Power, Adani Group, NTPC, MSME, Aditya Birla Group etc. It is expected collaborative work and funding towards addressing the immediate issues in their industries especially on fly ash utilisation in new areas of application especially for CSIR-AMPRI's manufacturing hybrid green composite materials.

There are tremendous potentials for application of hybrid green composite materials being developed in the present research program in civil infrastructure, construction, housing and in transportation system. Moreover, huge quantity of wastes produced from different industries can be used effectively as raw materials in making of such green composites. Realisation of this technology would results employment and income generation both for rural and urban people, reduce environmental pollution and avoid deforestation.

Photograph taken on occasion of Know-How transfer

Important Events

CSIR Integrated Skill Initiative Program (Phase-II)

Council of Scientific and Industrial Research (CSIR) is embarking upon "Skill India" mission of the Government of India under its 'CSIR Integrated Skill Initiative' Programme. Under this umbrella of skill India, CSIR laboratories have taken up various skill training programs under different domains on pan India basis. On 24th September, 2016 honorable Prime Minister Shri. Narendra Modi inaugurated "CSIR Platinum Jubilee" Celebration. On this occasion, Dr. Harsh Vardhan, Ex Minister of Science & Technology, Health & Family Welfare and Earth Sciences launched "CSIR Integrated Skill Initiative" programme on pan India basis in CSIR labs. The Second Phase of this programme has been launched in year 2020 for next 5 years (2020-25).

Mission: To generate quality human resource at various levels by providing and upgrading skills in all the possible fields.

Aims & Objectives:

The aims and objectives of the proposed programmes are;

- Upgradation of knowledge on latest technologies.
- Creating a pool of skilled human resource for industries.
- Developing employment oriented skill programmes.
- Aligning the skill programmes with CSIR Integrated Skill Initiative, National Skill Development Council (NSDC) and Sector Skill Councils (SSC) to meet the national objectives.
- Developing market / industry driven courses with emphasis on hands-on practical learning.

With a vision of a 'Skilled India', Council of Scientific and Industrial Research (CSIR), New Delhi has introduced skill program to comply with flagship scheme of the Ministry of Skill Development and Entrepreneurship. The aim of this program is to enable a large number of youth to take up industry- relevant skill training that will help them in securing a better job. To fulfill the same, CSIR-AMPRI, Bhopal has started different skill programs to make youth job oriented by imparting training under CSIR-Integrated Skill Initiative. Under the program, CSIR-AMPRI Bhopal is providing

training in following courses for different durations viz. One week / Two weeks / One month and others as per request, in form of training programmes / internships / dissertations etc.

1. Basic Skills in Science Laboratory Techniques
2. Heat Treatment, Metallographic and Mechanical Characteization
3. Electroplating and Surface Modifications Techniques
4. CNC Turner, Conventional Turner, Welder &Fitter
5. Analytical and Bio-analytical Chemistry
6. Electron Microscopy & Microanalysis
7. Water supply Engineering and Water Quality Analysis
8. Water Resources Management
9. Synthesis, Characterization and Application of Nanomaterials
10. Concrete Technology and Testing
11. R Programming
12. Renewable energy

During the FY 2020-21 CSIR-AMPRI, Bhopal has successfully trained 347 numbers of trainees in various skill-training programs and One day "National Skill India Program on Materials. Synthesis and Products for Self ReliantIndia"Further, an ECF of Rs. 6, 60, 800 has been generated during the FY-2020-21. **Glimpses of the programme are shown in photographs below:**

Additive Manufacturing (3D Concrete Printing)

CNC Turner Trainees certificate distribution

Electroplating of silver nanoparticle on ITO film and Gold nano particles on ITO film

Antimicrobial Coating on Cotton Fabric

Different approaches for removal of contamination from water with the help of nano hydroxyapatite

National Skill India Program on Materials Synthesis and Products for Self-Reliant India

The CSIR-Advanced Materials Processes Research Institute (CSIR-AMPRI) and Department of Physics has jointly organised "National Skill India Program on Materials Synthesis and Products for Self Reliant India" on 28-08-2020 (Friday) between 10:00AM to 1:00PM (IST) through ZOOM platform with live session in You Tube for school students, faculty members and research scholars.

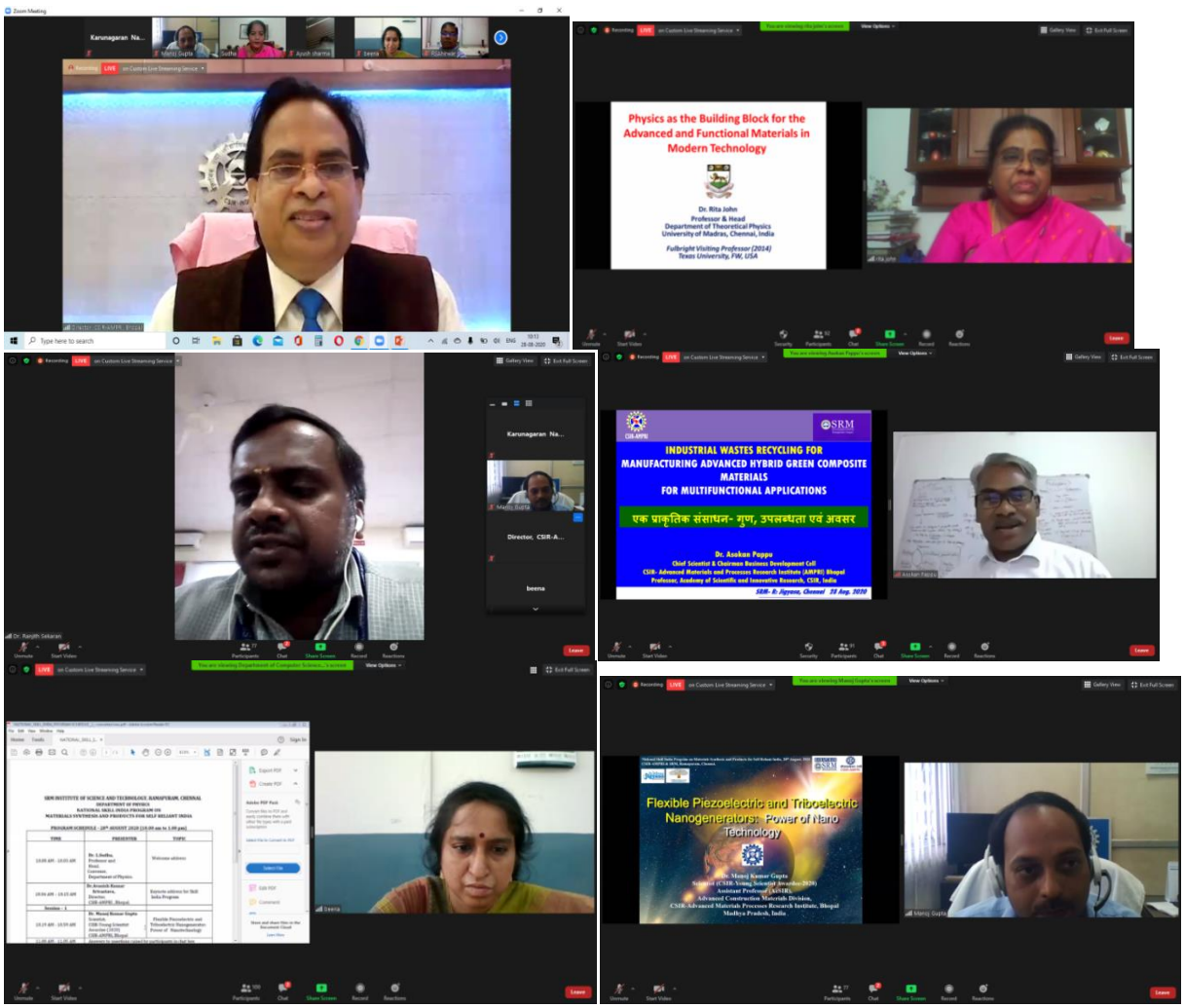
Dr. L. Sudha, HoD/Physics and Convener of the Program welcomed the gathering. Dr.Avanish Kumar Srivastava, Director, CSIR-AMPRI, Bhopal has delivered a keynote address for Skill India Program. In the first session, Dr. Manoj Kumar Gupta, Scientist, CSIR-AMPRI, Bhopal delivered lecture on the topic "Flexible Piezoelectric and Triboelectric Nanogenerator: Power of Nanotechnology ". He discussed Piezo and Triboelectric materials fabrication and applications.

In the second session, Dr.AsokanPappu, Chief Scientist and Chairman Business Development Cell, CSIR-AMPRI, Bhopal has delivered lecture on the topic "Industrial Waste Recycling for Manufacturing Advanced Hybrid Green Polymer Composite for Multifunctional Applications".He discussed elaborately about industrial waste recycling for multifunctional applications.

Finally, in the third session, Dr. Rita John, Professor and Head, Department of Theoretical Physics, University of Madras has delivered lecture on the topic "Physics as the building block for the advanced and functional Materials in modern Technology". He discussed about principles and advantages of spintronics and semiconducting materials.

We received overwhelming registrations, 300 participants including faculty from all over India, research scholars and school students attended the Skill India program. The participants raised

questions to the speakers and discussed the topics. The participants gave very good feedback. The **Glimpses of programme are shown in photographs below:**



Workshop on "Bamboo and Bamboo Wood for Industrial and Domestic Applications" at Agartala, Tripura

A Workshop on "Bamboo and Bamboo Wood for Industrial and Domestic Applications" was jointly organized by CSIR-AMPRI, Bhopal and Tripura State Council for Science and Technology, Agartala on March 1st, 2021 at PragnaBhavan, Agartala. The workshop was inaugurated by Shri Jishnu Dev Varma, Dy. Chief Minister, Govt. of Tripura. The workshop was graced by the presence of two IAS officials Smt. Tanusree Deb Barma, IAS, Member Secretary (Secretary for Science, Technology & Environment) and Shri Animesh Das, IAS, Additional Secretary & Director, Science,

Technology & Environment, Govt. of Tripura (Joint Member Secretary, Tripura State Council for Science & Technology). Dr. S.K.S Rathore, Chief Scientist, CSIR-AMPRI, talked about the Genesis of the program, future possibilities and highlighted the R & D activities carried out at CSIR-AMPRI, Bhopal. Dr. S.A.R Hashmi, Chief Scientist, CSIR-AMPRI highlighted the importance of bamboo composites over the conventional materials of construction. Dr. Sanjeev Saxena, Senior Principal Scientist, CSIR-AMPRI, gave an account of technical details involved in this developmental work.

The workshop was attended by Entrepreneurs/ Industrialists/ Bamboo Harvesters/ Students. After the lunch break, technical session which included presentations from three scientists were included. Dr. S.A.R Hashmi, Chief Scientist gave his talk on "Role of local bamboo in construction of eco housing of future", highlighting the importance of the bamboo composites for structural applications in construction industries. Dr. Sanjeev Saxena, Senior Principal Scientist, presented a talk on "Mechanical behavior of Bamboo composite material and methods of joining" and Ms. MedhaMili, Scientist, gave a talk on "Bamboo varieties, various treatment and its applications". The technical sessions were followed by an open discussion with the Entrepreneurs/ Industrialists/ Bamboo Harvesters/ Students which then ended with a vote of thanks.**Glimpses of programme are shown in photographs below:**

Workshop on "Bamboo and Bamboo Wood for Industrial and Domestic Applications" at Meghalaya, Shillong.

CSIR-AMPRI, Bhopal and Meghalaya Basin Development Authority (MBDA), Shillong, Meghalaya jointly organised a Workshop on "Bamboo and Bamboo Wood for Industrial and Domestic Applications" on March 4th, 2021 at Venue: Conference Hall, State Convention Centre, Shillong.The workshop was attended by various Entrepreneurs/ Industrialists/ Bamboo Harvesters/ Students. Shri

Aiban Swer, Director, MBDA, Shillong addressed the gathering with his welcome speech. Dr. S.K.S Rathore, Chief Scientist, CSIR-AMPRI, talked about the Genesis of the program and future possibilities of the interaction of the workshop. Dr. S.A.R Hashmi, Chief Scientist, CSIR-AMPRI, gave a lecture on "Role of local bamboo in construction of eco housing of future" highlighting the role and importance of bamboo in construction industries. Dr. S. Murali, Senior Principal Scientist, CSIR-AMPRI, delivered a talk on "Bamboo resources and utilization of materials development in India with special reference to Meghalaya state" and Dr.SarikaVerma, Principal Scientist, CSIR-AMPRI, gave a talk on "Bamboo: A green gold for various applications". The presentations were followed by a discussion with the Entrepreneurs/ Industrialists/ Bamboo Harvesters/ Students which then ended with a vote of thanks.

Glimpses of programme are shown in photographs below:

Webinar on "Bamboo Technologies for Sustainable Livelihood" during 18th - 19th September 2020 on MS Teams

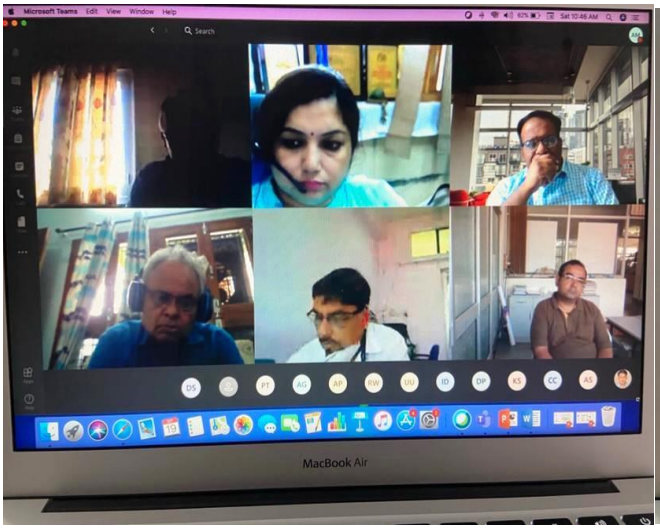
Two days Webinar on "Bamboo Technologies for Sustainable Livelihood" was being organisedduring 18th - 19th September 2020 by CSIR-AMPRI, Bhopal on the occasion of 11th World Bamboo Day on MS Teams. Dr.Avanish Kumar Srivastava, Director, CSIR-AMPRI, Bhopal welcomed all the guests & presented a brief outline of "CSIR-AMPRI's R & D aspects on Bamboo". Dr. S.K.S Rathore, Chief Scientist, CSIR-AMPRI, talked in his introductory remarks about the theme

of the webinar and gave the details of the programme. Dr. Sanjay Kumar, Director, IHBT Palampur graced the occasion with his presence and presented his plenary lecture on "Technological Interventions For Propagation, Conservation and Value Addition in Bamboos at CSIR-IHBT", highlighting the bamboo based R & D Interventions at IHBT as well as Societal and Economic Interventions. The programme had total eight technical lectures. Dr. S. Murali,Senior Principal Scientist, CSIR-AMPRI, gave a lecture on "Bamboo Resource in India: Potential and Prospects for Materials Development". Dr. S.A.R Hashmi, Chief Scientist, CSIR-AMPRI, delivered a talk on "Modern Bamboo Composites for Structural & Engineering Applications" highlighting the importance of this bamboo composite technology for potential application in construction industries as well as the societal benefits in terms of employment generation and economic development. The first day of the webinar also had lecture from Dr. Lal Singh, Senior Scientist, CSIR-IHBT, who presented a talk on "Development of Bamboo Diversity on Waste/Degraded/Contaminated Land using Eco rejuvenation Technology".

The second day of the webinar started with a talk by Er. K.K. Singh, Chief Scientist, CSIR-IHBT on "Bamboo Technology for Sustainable Livelihood" and spoke about the importance of bamboo as a boon for sustainable employment generation and livelihood. Dr. Sanjeev Saxena, Senior Principal Scientist, CSIR-AMPRI, delivered a lecture on "Evaluation of Mechanical Strength of Bamboo Strips, Bamboo Composite Material and Joints in it". Dr.PritiShivhare Lal, Scientist E-II, CPPRI, Saharanpur, talked about the "Utilization of Bamboo for Production of Various Grades of Pulp and Paper". Also, a talk was delivered jointly by Dr.SarikaVerma, Principal Scientist, CSIR-AMPRI and Ms. MedhaMili, Scientist, CSIR-AMPRI about the "Potential of Lignin derived Material from Bamboo for Multi-functional Applications." The webinar was also attended by Mr. Mihir Merchant, Director, Ms. Permali Wallace Pvt., Ltd, Bhopal and gave an overview of the company and scope and market potential of the CSIR-AMPRI's bamboo composite technology. The webinar was attended by academicians, scientists, industrialists as well as other participants. In addition to technical discussion, possibilities of collaborative interactions were also explored.

Valedictory function was presided over by Dr.Avanish Kumar Srivastava, Director, CSIR-AMPRI and Dr. S.A.R, Hashmi, Chief Scientist,CSIR-AMPRI summarised the overall programm. After conclusions, Ms. MedhaMili, Scientist, CSIR-AMPRI, proposed the vote of thanks to all.

Glimpses of programme are shown in photographs below



Workshop on "Innovations in Material Science for Biomedical Applications"

CSIR-AMPRI Bhopal organized two days workshop in virtual mode on "Innovations in Material Science for Biomedical Applications", supported by SERB (Government of India) New Delhi during 24th and 25th February 2021.

Nine lectures were delivered by eminent speakers on 25th February 2021 which was concluding day of workshop,These lectures were distributed in three technical sessions.

In the first 1st session Dr Bipin Kumar Gupta, Principal Scientist, CSIR-NPL, New Delhi discussed about magnetic nanoparticles for different applications such as diagnostic and targeted drug delivery etc.

Dr. Pratima Solanki, Assistant Professor, JNU, New Delhi. She discussed that how tunable fluorescent properties of carbon dots are useful for the development of biosensors.

3rd talked delivered by Professor J.P. Singh, IIT, New Delhi. He discussed about of indigenous handheld SERS platform for rapid detection of human immunodeficiency virus (HIV-1). Prof Singh also discussed about SERB based ultra-sensitive, rapid, portable platform for detection of pathogenic bacteria and dengue virus.

In 2nd session 1st talk was delivered by Raju Khan, Principal Scientist, CSIR-AMPRI, Bhopal. Dr Khan discussed about the impact of nanomaterials on the accuracy of biosensor based devices in early detection and highly sensitive based of biomarkers such as cardiovascular, neurotransmitter, cancer, and SARS-CoV2.

2nd talk was delivered by Professor Ashok Kumar, AIIMS, Bhopal. Professor Kumar talked about identification of novel prognostic cancer biomarkers by using computational tools.

3rd talk was delivered by Dr N Sathish, Principal Scientist, CSIR-AMPRI, Bhopal. Dr.Sathish talked about application of additive manufacturing for bio medical applications.

In 3rd session 1st talk was delivered by Dr Neha Arya, NIPER, Ahmedabad. Dr. Arya discussed the various 3-D tumor models that have been developed by her group along with their applications in pre-clinical research.

2nd talk was delivered by Dr Chetna Dhand, Senior Scientist, CSIR-AMPRI, Bhopal. Dr Dhand discussed about The applicability of these crosslinkers in designing the antimicrobial wound dressing materials was explained by her.

3rd talked was delivered by Dr Gaurav Kumar Gupta, Principal Scientist, CSIR-AMPRI, Bhopal. Dr. Gupta presented the biocompatibility of Titanium and Stainless-steel alloys for variety of orthopedic applications.

After three sessions, workshop was concluded with address of Director, CSIR-AMPRI, Bhopal. Concluded session was moderated by Dr. Surender, Scientist , CSIR-AMPRI, Bhopal. After Online feedback was taken from Speakers and audience. Report of Webinar was presented by Dr.Raju Khan, convener of workshop. Dr. Mohd. Akram Khan, Senior Principal Scientist was Chairman and Dr. Chetna Dhand, Senior Scientist was Co-Convener of workshop.

Dr. Shabi, Scientist, CSIR-AMPRI, Bhopal proposed vote of thanks at the end of workshop.

Glimpses of programme are shown in photographs below

Phenome India - A long term longitudinal observational cohort study CSIR Serosurvey

Background-India has been amongst the most affected nations during the SARSCoV2 pandemic, with sparse data on country-wide spread of asymptomatic infections and antibody persistence. This longitudinal cohort study was aimed to evaluate SARS-CoV2 sero-positivity rate as a marker of infection and evaluate temporal persistence of antibodies with neutralization capability and to infer possible risk factors for infection.

Raju Khan, Principal Scientist, working as a Nodal Scientist for Serological Sample Collection Under the CSIR-Cohort at CSIR-AMPRI

CSIR-AMPRI have been collected the blood samples for analysis of SARS-CoV-2 antibodies 3 times as on 13-07-2021-14-07-2021.

Glimpses of programme are shown in photographs below

Jigyasa Programme

S.No.	Science Outreach & Popularisation activities
01.	Webinar on Commendable efforts of CSIR -AMPRI to deal with COVID – 19. Date 8.4.2020

02	Webinar on Prevention and Fight against Coronavirus - A virus which is spreading fast globally and causing COVID -19 disease. Date 29.4.2020.
03.	Webinar on National Technology day on "Nanostructure Material and their Applications". Date 11.5.2020.
04.	Webinar on "Electron Microscopy and Spectroscopy" for school students. Date 18.5.2020.
05.	Webinar on World Environment day on the topic "Environmental Impact Assessment". Date 5.6.2020.
06.	Success Story of Translational Research - A Webinar under CSIR -Jigyasa Programme. 24.7.2020.

National Skill India Programe on Materials Synthesis and Products for Self Reliant India

One day on-line seminar was organized by CSIR-Advanced Materials Processes Research Institute (CSIR-AMPRI) with SRM Institute of Science & Technology, Ramapuram, Chennai on National Skill India Programe on Materials Synthesis and Products for Self Reliant India" under CSIR – Jigyasa on 20th August, 2020.

MoU signed between MPCST, Bhopal and CSIR-AMPRI Bhopal

Photograph taken on occasion of signing of MOU

Initiatives of CSIR-AMPRI, Bhopal towards fighting against COVID19 in rural areas of M.P. and Chhhattisgarh state

To address problem of Covid-19, CSIR-AMPRI, Bhopal targeted few villages of Bhopal and Sehore districts of Madhya Pradesh like Shahpur, Ratatal, Kresar (Shahpur), BarkhediHazzaam, Khajuri of Berasia Block, Bhopal district, about 15 villages viz. Bhaukhedi, Kheri, Alla, Nipaniya, Mohodia of Sehore Block, KhajuriyaKasam, Neelbad, Aroliapar, Sevda, Darkheda, Tigariya, Arniyagazi, Karmankhedi etc. of Ashta block, Sehore District and also few villages of Mahasamund district of Chhattisgarh for creation of awrenessamog the rural people and distributed pamphlets /posters providing information on practices to be followed regarding hygiene, hand washing, social distancing to prevent spread of infection in hindi language and also distributed materials like soap and masks to them so that villagers can visualize importnace of these materials in current situation. For the distribution of these materials to villagers, CSIR-AMPRI, Bhopal had contacted many NGOs, Social organisations and voluntary organisations. Finally, Vidya Bharati agreed to support for distribution of material and pamphlets /posters along with creating awareness among them on the basis of information revealed in posters and pamphlets.These materials were taken by AMPRI officials on 3rd April, 2020 to the villages viz. Shahpur, Berasia Block, Bhopal district and handed over to Manager, Vidya Bharati Grameen Shiksha Anandteerth Mata Vedari Shahpur for the distribution.

Principal and former teacher of the school along with workers of Vidya Bharati distributed the material in Shahpur, Ratatal, Barkhedi Hajjam, Khajuri, Binapur and Golkhedi villages during 4th April to 6th April 2020. During distribution, they also made the villagers aware about safety aspects and to get protection from the transmission of the disease.(Phtographs below)

Director CSIR-AMPRI, Bhopal monitoring arrangements at CSIR-AMPRI gate for sending materials and pamphlets to rural areas for distribution.

Distribution of pamphlets and creation of awareness among villagers regarding prevention from infection due to Coronavirus (COVID-19)

Visit of Dr. Harsh Vardhan, Honorable Minister of Science and Technology, Health & Family Welfare and Earth Sciences and Vice President, CSIR, Government of India, New Delhi to CSIR-AMPRI, Bhopal

Dr. Harsh Vardhan, Honorable Minister of Science and Technology, Health & Family Welfare and Earth Sciences and Vice President, CSIR, Government of India, New Delhi, visited CSIR-Advanced Materials and Processes Research Institute(CSIR-AMPRI), Bhopal on March 13, 2021 and inaugrated Centre for Advanced Radiation Shielding and Geopolymeric Materials and Analytical High Resolution Transmission Electron Microscope Laboratory. Honorable Minister laid the Foundation Stone of CSIR-AMPRI Bamboo Composite Structure 'BAITHAK' and released the Fly Ash compendium of CSIR - AMPRI. Honorable Minister , Bhopal and appreciated the work .Honorable Minister also graced the occasion of the signing ceremony of the MoU among MSME, Govt. of MP, MPCST, Vigyan Bharati and CSIR.

Glimpses of Visit of, Honorable Minister at CSIR-AMPRI are shown below

Inaugration of Centre for Advanced Radiation Shielding and Geopolymeric Materials

Laying the Foundation Stone of CSIR-AMPRI Bamboo Composite Structure 'BAITHAK

Inaugrationof Analytical High Resolution Transmission Electron Microscope Laboratory

Honorable Minister releasing the Fly Ash compendium of CSIR - AMPRI, Bhopal

Visit of Honorable Minister to exhibits of CSIR - AMPRI, Bhopal

6th India International Science Festival (IISF – 2020)

The 6th India International Science Festival (IISF – 2020) held in Virtual format during December22- 25, 2020 on the theme " Science for Self-Reliant India and Global Welfare". IISF - 2020 is an integral part of India's long-term vision in developing the spectrum of scientific temper in India and abroad. The objective of this programme is to showcase the Indian science achievements and innovations for the students, young researchers, industries and general public and to display India's contribution in the field of S&T and to motivate the young scientists to find solutions to the burning issues of our societies is an annual event organised jointly by Ministries and Departments of the Government of India and Vigyan Bharati (Vibha).

CSIR-AMPRI, Bhopal was the Principal Organizing Institute for the event-Traditional Crafts and Artisan Meet and Expo, 41 events will take place during IISF, during 6th IISF – 2020, December 22-25, 2020.

Following series of different programmes were organized and successfully conducted during IISF 2020, in the leadership of Dr. AK Srivastava, (Director-AMPRI), Dr.Mohd. Akram Khan, Principal coordinator, Dr. Sarika Verma, Coordinator,Dr. Edward Peter,Coordinator along with other team members.

1.Curtain Raiser of the India International Science Festival (IISF-2020). November 27, 2020.

As a Curtain Raiser of IISF – 2020, a one-day programmewas organized at CSIR – Advanced Materials and Processes Research Institute, Bhopal on November 27, 2020. Sadhvi Pragya Singh

Thakur, Hon'able Member of Parliament was the Chief Guest of the programme. **Glimpses of programme are hown Below:**

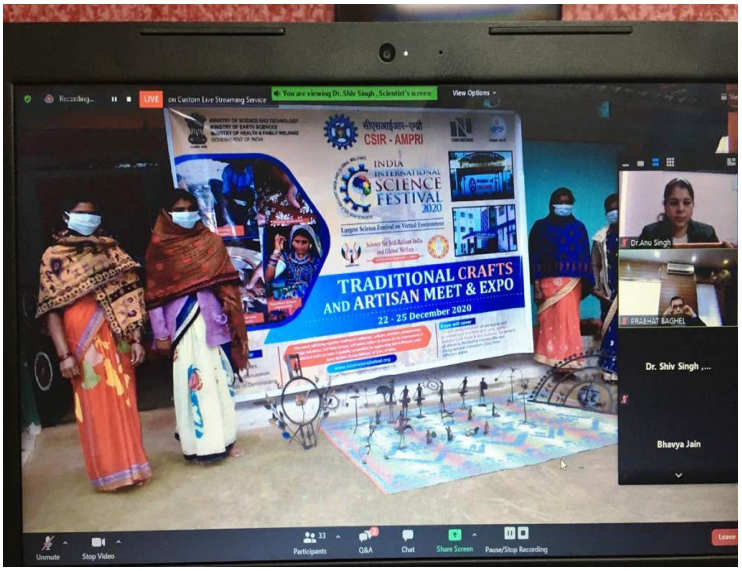
Director CSIR-AMPRI presenting momento to Sadhvi Pragya Singh Thakur, Hon'able Member of Parliament on Curtain Raiser of IISF – 2020.

2. Vigyan Yatra (Homi J. Bhabha Yatra-West to Delhi) organized under IISF- 2020

CSIR—AMPRI, organized Vigyan Yatra (Homi J. Bhabha Yatra-West to Delhi) ,IISF – 2020, in Virtual Platform on December 15, 2020. Dr. Anil Kothari, DG, MP Council of Science and Technology was the Chief Guest on occasion. Shri Krishnendu Chaudhury, Project Coordinator, Regional Science Centre, Shri Mankaj Kumar Singh, Director, M/s MW Social Enterprise Pvt. Ltd., Indore; Sh. Arun Kumar Sahu, CMD, Shubh Green Sheets Pvt. Ltd., Durg and Shri Abhay Raj Singh Bhandari, COO, Bharat Oman Refineries Ltd., Beena graced the occasion.

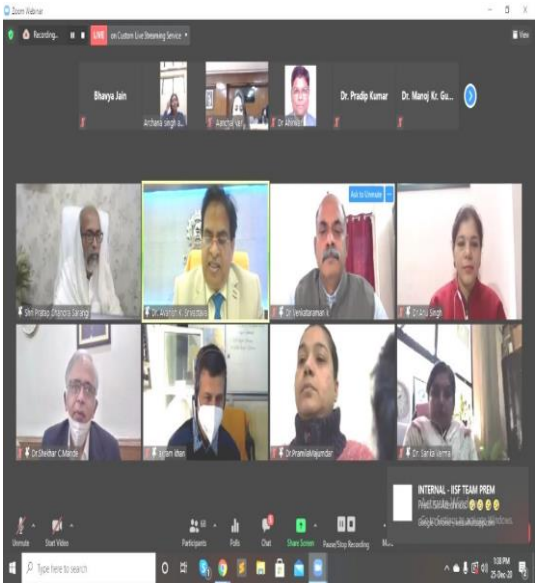
3 Inaugration and Valedictory, IISF 2020 (22- 25, Dec 2020)

Inauguration of Traditional Crafts and Artisan Meet and Expo, IISF-2020 was organized on virtual platform on 22nd December 2020. Dr.Sunil Kumar, Vice Chancellor, Rajiv Gandhi Proudyogiki Vishwavidyalaya, Bhopal was the Chief Guest on occasion and Dr. Sharada Srinivasan, Professor, NIAS, Bengaluru was the Guest of Honor for the event.Dr. A. K. Srivastava, Director, CSIR-AMPRI have welcomed the guests and provided a brief overview over the origin of IISF.**Glimpses of programme are hown Below**:



Inauguration programme for the event-Traditional Crafts and Artisan Meet and Expo, IISF 2020

Shri Pratap Chandra Sarangi, Hon'ble Union Minister of State, Ministry of Micro, Small and Medium Enterprises, Ministry of Animal Husbandry, Dairying and Fisheries was the Chief Guest, along with the Guest of Honour, Dr. Shekhar C. Mande, Director General, CSIR & Secretary, DSIR. Welcome address and Vote of Thanks was delivered by Dr.Avanish Kumar Srivastava, Director, CSIR-AMPRI , Bhopal in the Valedictory programme for the event-Traditional Crafts and Artisan Meet and Expo , IISF 2020



Valedictory programme for the event-Traditional Crafts and Artisan Meet and Expo, IISF 2020

Award/Achievements of Staff and Students

1. On an independent study done by Stanford University scientists , the name of Dr.Avanish Kumar Srivastava,Director, CSIR-AMPRI appeared in top 2 % scientist in applied physics in subject-wise ranking of top 2% scientist from India.

शहर में हो रहे पानी से इंडस्ट्रियल डाई हटाने, गाड़ियों को हाइब्रिड बनाने और पराली से फर्नीचर बनाने जैसे रिसर्च

दुनिया के टॉप 2% वैज्ञानिकों में शामिल भोपाल से 11 साइंटिस्ट

गर्व की बात

सिटी रिपोर्टर। अमेरिका की स्टैनफोर्ड यूनिवर्सिटी ने विज्ञान के सभी क्षेत्रों के दुनिया के टॉप-2 प्रतिशत वैज्ञानिकों की सूची जारी की है। खास बात यह है कि इस सूची में भोपाल के 11 वैज्ञानिक शामिल हैं। इनमें 3 मैनिट से, 3 आईसर से, 1 एनआईटीटीआर से और 4 वैज्ञानिक सीएसआईआर-एम्प्री से हैं।

▪ **आलोक मित्तल,** मैनिट वर्ल्ड रैंक - 638
रिसर्च पेपर - 550, साइटेशंस - 11000+

पानी में इंडस्ट्रियल वेस्ट के तौर पर घुलने वाली डाई यानी रंगों को पानी से वापस निकालने पर रिसर्च की है। पानी से रंग को अवशोषित (एडजॉर्प) करने वाले चार नए अवशोषक (एडजॉर्पेंट) खोज, जो सोसायटी में वेस्ट की तरह देखे जा रहे हैं। इनमें बॉटम ऐश और डी-ऑयल्ड सोया के अलावा मुर्गे के पंख, एग शेल और मेम्ब्रेन पर रिसर्च की है।

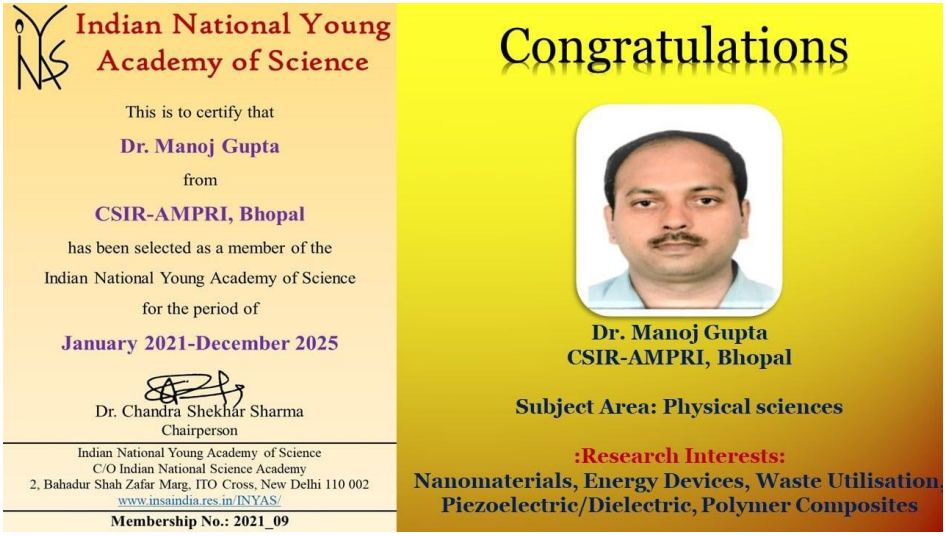
▪ **अवनीश श्रीवास्तव,** सीएसआईआर-एम्प्री, रैंक : 4400 रिसर्च पेपर : 250, साइटेशंस - 4900+

एडवांस्ड और नैनो मटेरियल्स पर बीते 30 सालों से काम कर रहे हैं। अवनीश ने इलेक्ट्रॉन हाई रिजॉल्यूशन माइक्रोस्कोपी पर रिसर्च की, जिससे किसी भी चीज के अणुओं को भी देखा जा सकता है। पराली बर्निंग की समस्या से निपटने के लिए पराली का इस्तेमाल कर प्लाईवुड तैयार किया, जिससे इसका इस्तेमाल ऑफिस फर्नीचर और लड़की के तौर पर किया जा सकता है।

ये भी हैं शामिल मैनिट के ओपी मोदी, शैलेन्द्र जैन, आईसर भोपाल से कंकन भट्टाचार्या, दीपक चोपड़ा, नितिन टी पाटिल, सीएसआईआर-एम्प्री से डॉ. एस दास, बीके प्रसाद, नवीन चंद्रा और एनआईटीटीआर से स्व. पदमाकर वी खड़ीकर शामिल हैं।

2. Dr N. Sathish: Joint Secretary of Electron Microscope Society of India.
3. D. P. Mondal : International Golden Research Award' 2020 in the Area of "Cellular Materials and Metal Matrix Composites" to Dr. by ISSN and Research Bureau Veritas.
4. Dr. D. P. Mondal: Appreciation for most efficient Reviewer for Transaction of Indian Institute of Metals, Springer.
5. Dr. Manoj Kumar Gupta: Prestigious CSIR Young Scientist Award in the Physical Sciences (including instrumentation)-2020 for his excellent work on developing the novel and innovative piezoelectric and turboelectric nanogenerator as new class of renewable energy devices that generate electricity from tiny mechanical vibration and development of electrical insulating sheet from industrial wastes such as fly ash, marble, stone waste and other particulates.

6.Dr. Manoj Kumar Gupta: Member of member of prestigious Indian National Science Academy (INSA)-Indian National Young Academy of Science (INYAS), Govt of India (2021-2025) in Physical Sciences subject.



7.“National Meritorious Invention Awards” from National Research Development Corporation (NRDC) for innovation of "Lead Free X-ray Shielding Red Mud Tiles", March 2021.

Awardees: Dr.ShabiThankarajSalammal , Dr. Sunil .K. Sanghi, Dr. Deepti Mishra, Dr.Rini Paulose, Ms. Varsha Agrawal, Mr. Rahul Arya, Mr. Akshay Singh Tomar, Dr.Sanjai Kumar Singh Rathore, Dr.Avanish Kumar Srivastava

8. Prabhat Kumar Baghel: Member of Team at CSIO, Chandigarh now at CSIR-AMPRI was awarded ‘Most significant CSIR technology for five years plan’ for developing Head Up Display

Variants and Associated Test Equipment for Multiple Aircraft Platforms in association with Aeronautical Development Agency (ADA), Bengaluru and Bharat Electronics Limited, Panchkula.

9. Dr.Avanish Kumar Srivastava, ,Director, CSIR-AMPRI , Bhopal: President Electron Microscopy Society of India 2020- Continuing.
10. Dr. Avanish Kumar Srivastava, Director, CSIR- AMPRI , Member, Governing Council, Technology Information Forecasting and Assessment Council, (TIFAC),DST, Govt. of India

Invited Talk Delivered

1. Dr. Manoj Gupta :Delivered a Special lecture on "Relevance of Nanogenerator" at Department of Applied Physics BBA Central University, Lucknow, 11th February, 2020.
2. Dr. Manoj Gupta: Delivered Invited talk on "Piezoelectric Flexible Nanogenerator : A New and Renewable Energy Source" At National Webinar organised by Shiva ji College, University of Delhi on April 22, 2020.
3. Dr.ShabiThankarajSalammal, Flexible Electronics, Recent Trends and Challenges in Advanced Physics -2020, organised by Nanjil Catholic College of Arts &Science, 04th June 2020.
4. Manish Mudgal: Delivered Key Note Address on Environmental Impact Assessment for Industrial Projects on 5th June 2020 i.e World Environment Day organised by under Jigyasa Programme of CSIR-AMPRI Bhopal.
5. Dr. Manoj Gupta : Delivered lecture as Invited Speaker Transparent Flexible and Stretchable Piezoelectric Nanogenerators for Energy Harvesting, at Nanoscoence and Nantechnology in present Scenario Special Centre for Nano Sciences Jawaharlal Nehru University, Delhi-110067 during 9-10 June, 2020.
6. Neeraj Dwivedi: Ultrathin films for advanced protection of magnetic storage systems, Recent Advances in nanoscience and its applications, Jawaharlal Nehru University (JNU), New Delhi, 28 July, 2020.
7. Dr.AsokanPappu delivered an invited lecture titled "Industrial and hazardous waste management. National Training Programme on "Audit of Waste Management" from 24th to 28thAugust, 2020, for officers of Indian Audit & Accounts Department. International Centre for Environment Audit and Sustainable Development (ICED-CAG), Jaipur. Virtual Mode on 25 Aug. 2020.

8. Dr. Asokan Pappu delivered an invited lecture titled “Industrial wastes recycling for Manufacturing advanced hybrid green composite materials for multifunctional applications”. National Skill India (Jigyasa) Programme on Materials Synthesis and Products for Self Reliant India. SRM Institute of Science and Technology, Chennai. Virtual mode, SRM, Chennai on 28 Aug.2020
9. Sarika Verma, Medha Mili, SAR Hashmi, Potential of lignin derived material from bamboo for multi-functional applications, Webinar on bamboo technologies for sustainable development,18th-19th September 2020.
10. Dr. Rajeev Kumar: Development of lightweight carbon composite foam for electromagnetic interference shielding, सूक्ष्म पदार्थ एवं सम्बद्ध चेतन ऊर्जा पर राष्ट्रीय ऑनलाइन संगोष्ठी at School of Physical & Decision Science, Babasaheb Bhimrao Ambedkar University, Lucknow, 27-29 September, 2020.
11. Dr. Manoj Gupta :Delivered Invited talk on Flexible Piezoelectric Nanogenerators and Advanced Hybrid Composites for Multifunctional Application on Young Scientist awardees Confabulation programme organised by CSIR-HRDC, Ghaziabad on 29th September, 2020.
12. Dr.Asokan Pappu delivered an invited lecture titled ‘Development of Biodegradable, Energy Efficient and Sustainable composites from natural fibers, agro-industrial waste particulates and Bio-binder system”.Industry, Academia Excellence, Nobel Practices & Pragmatic Management towards Resources sustainability in the filed of Science and Engineering.PSG Collage of Technology, Coimbatore,Virtual mode on 6 Oct.2020
13. Manish Mudgal: Delivered an Expert Lecture on Industrial Siting & Environmental Impact Assessment online training programme on " Industrial- Chemical Safety: Law, Policy and Planning Framework" 13 October 2020.
14. Dr.AsokanPappu delivered an invited lecture titled “ Agro waste Management Technology. Brainstorming workshop on Utilisation of Agro/ Biomass waste: Roadmap & Strategy. CSIR-HRDC Ghaziabad. Virtual mode, CSIR- HRDC Ghaziabad on 28 Oct.2020.
15. Dr. Manoj Gupta :Delivered a Special lecture on the programme Koffee With… at Asnani School, Bhopal, 31-10-2020
16. Manish Mudgal: Delivered Invited Talk on Innovative Advanced (Cement Free)Fly ash based Geopolymer Concrete for Infrastructural applications in BITCON 2020 on 20th November2020 Organized by Bhilai Institute of Technology , Durg (CG)

17. Dr. Chetna Dhand: Nano-enabled smart approaches for Biosensor Development, , AICTE Training and Learning (ATAL) and Academy sponsored "Online Faculty Development Programme (FDP)" organized by CSIR-AMPRI, 16th -20th November 2020.
18. Light weight materials for automobile Applications, D. P. Mondal, FDP, NIT, Surat, 20th Nov, 2020.
19. Pradip Kumar: 2D materials: Synthesis, properties and applications, 18th Refresher Course in Physical Sciences & Nano Sciences, JNU, New Delhi, 25 November, 2020.
20. Gaurav Gupta: Multilayer armour for personal and Vehicle armour application, Webinar on "Advanced materials and technologies for defence: present status and future needs" Organized by CSIR-AMPRI, 5th-6th Dec. 2020.
21. D. P. Mondal: Hybrid foam for blast resistance Applications, Webinar on "Advanced materials and technologies for defence: present status and future needs" Organized by CSIR-AMPRI, 5th-6th Dec. 2020.
22. Dr.ShabiThankarajSalammal, Red mud based new generation X-ray shielding tiles, India-Russia Scientific Webinar on Materials Science, New Materials and Nanotechnology, 2020, organised by Russian Academy of Science and Indian Embassy. 09th December 2020.
23. Dr. Manoj Gupta :Delivered a Special lecture on DG's Meeting with Directors of CSIR on Piezoelectric flexible nanogenerators under theme of Young Scientist on New / Futuristic Idea on 17 December, 2020. .
24. Dr.ShabiThankarajSalammal, X-ray shielding red mud tiles as an alternative of toxic lead, International conference on futuristic materials (ICFM-20), organised by D.D.U Gorakhpur University, 19th December 2020.
25. Dr.Asokan Pappu delivered an invited lecture titled "Technology and opportunities for sustainable employment and income to urban and rural. India International Science festival. VIBHA, CBRI on Habitat: Urban and Rural. Virtual modeIISF 2020, Habitat: Urban and Rural, Organised by CBRI, Roorkee on 23 Dec. 2020
26. Gaurav Gupta: An Insight into Metallic Composites and foams, , Faculty Development Program at Ravindranath Tagore University, 12th Jan, 2021.
27. D. P. Mondal and Gaurav Gupta: Research on Syntactic Foam at CSIR-AMPRI, Syntactic foam Research and Applications: an Update from Asia Pacific Region, Organized by University of New York. 14th Jan, 2021.

28. Dr. Manoj Gupta : Delivered Invited talk on CSIR Young Scientists Conclave Meet 2021 organised by CSIR-CSMCRI, Bhavnagar. 22th January, 2021.
29. Dr. Chetna Dhand: Self-Defensive Antimicrobial Coatings for Infection Prevention, , Rabindranath Tagore University , 29 January 2021.
30. Dr. Manoj Gupta:Delivered Invited talk on "Large Scale Utilization of Industrial Inorganic and Agro-Waste for Multifunctional Advanced Hybrid Composite and Environmental Sustainability on International E- Conference on Multifunctional Material and Environment (E-ICMME-21) Venue: University Department of Chemistry, LNMU Darbhanga, 31th January, 2021.
31. D. P. Mondal: Light weight materials for tribological Applications, FDP, NIT, Surat, 16th February, 2021.
32. Gaurav Gupta: Metallic foam for Biomedical Application, Webinar on "Innovation in Materials Science for Biomaterials Applications", Organised by CSIR-AMPRI, 24-25th February, 2021.
33. Dr Raju Khan: Delivered Talk "Nanomaterials based biosensors for detection of biomarkers", SERB supported workshop on "Innovation in material Science for Biomedical applications" on 24-25, February 2021 at CSIR-AMPRI, Bhopal.
34. Sarika Verma, Bamboo- a Green Gold For Various applications, Bamboo and bamboo wood for industrial and domestic applications, AMPRI, Bhopal& Meghalaya Basin Development Authority (MBDA), Shillong, Meghalaya,4th March 2021.
35. Sarika Verma, Panelist in Panel Discussion on the topic 'Diversity and Inclusion, ASM International Pune Chapter in International women Day, 6th March, 2021.
36. Dr.Asokan Pappu delivered an invited lecture titled "CSIR AMPRI's Technologies & opportunities. Industry Meet. ALCON Anil Counto Enterprise, Goa, CSIR-AMPRI, Bhopal & IIT, Goa. Virtual mode on 10 March 2021.
37. Dr. Chetna Dhand: Nanotechnology Enabled Antimicrobial Solutions for Infection Control, , AIIMS-AMPRI Blended Symposium on 3D Printing in Dental & Medical Sciences held at AIIMS, Bhopal, 13th March 2021.
38. Raju Khan: Delivered Talk ""Electrochemical biosensors in Point of Care Diagnostics", AIIMS – AMPRI Blended Symposium On 3D Printing in Dental & Medical Sciences, AIIMS, Bhopal," on 13th March 2021, at AIIMS, Bhopal.

39. Raju Khan: Delivered Talk ""Role of Nanotechnology in Biosensor Applications" Faculty Development Program on "Interdisciplinary Aspects of Nanotechnology", on 13th March 2021, at RGPV, Bhopal
40. Manish Mudgal: Delivered Key Note Address on Advanced Geopolymer Concrete for Infrastructure application on 16 March 2021 at XLIV Indian Social Science Congress, March 15-19, 2021, Samrat Ashok Technological Institute, Vidisha,M.P.

Publication of a Journal

CSIR-Advanced Materials and Processes Research Institute (AMPRI) Bhopal in collaboration with CSIR-National Institute of Science Communication and Information Resources, New Delhi has published multi-disciplinary Journal entitled "Applied Innovative Research" with ISSN 2581-8198 (online). Vol. 2(2) of the journal was published in June 2020 and Vol.02 (3) September 2020 were published.

Dr. A. K. Srivastava, Director CSIR-AMPRI, Bhopal is the Chief Editor of the Journal.

Dr. J. P. Shukla is executive Editor of the journal from CSIR-AMPRI Bhopal.

AcSIR-AMPRI (2020-2021)

CSIR_Advanced Materials and Processes Research Institute (AMPRI), Bhopal, under the aegis of AcSIR (Academy of Scientific & Innovative Research (AcSIR – AMPRI) offers an Opportunity to Students for Higher Education in Interdisciplinary Research Areas & to Work with World Class R & D Experts, in the following courses;

- Ph.D. in Engineering (Material Science & Technology)
- Ph.D. in Chemical Science
- Ph.D. in Physical Science
- Integrated Dual Degree Program (IDDP)

  M.Tech. + Ph.D. in Engineering (Material Science & Technology)

AcSIR-AMPRI, Bhopal is running PhD courses in Engineering Science since 2014. There are two semesters each year, starting from January and August and students are admitted in both the semester. The selection procedure is stringent, AcSIR invites applications and candidates are selected based on their credentials, for the written examination/ interview by the individual CSIR Institutions.

In 2020-2021 sessions, total 25 students got registered in AcSIR-AMPRI; Ph.D in Engineering: 7, Ph.D. in Chemical Science:8 Ph.D. in Physical Science : 6 and Ph.D under IDDP:4 . 12 students took admission in August 2020, 7 students took admission in January 2021 and 6 students took admission in August 2021. As compared to previous year i.e. 2019-2020, admission of students in 2020-2021 has increased by 72%.

Five students were awarded Ph.D. this year and three students submitted thesis. For the progress evaluation of students 16 DAC meeting were conducted.

Presently the number of faculties in AcSIR-AMPRI Bhopal is 46 (Engineering 28, Chemical Sciences 12 and Physical Sciences 6). The courses offered at AcSIR-AMPRI, Bhopal are 28 in Material science and Engineering, 29 in Chemical Sciences and 12 in Physical Sciences.

Pass out students of AcSIR Mr. Bishnu Nand Yadav has joined Chonnam University, South koria as Post Doctoral Fellow, Mr. Karan Singh Verma is appointed Asst. Professor, in Oriental College of Engineering, Bhopal, Mr. Dhiraj has joined IIT, Delhi as Post Doctoral Fellow, Ms. Amit Abhash joined Sagar Engineering College, Bhopal as Asst. Professor.

Staff list as on 31.03.2021

Scientific Staff

Sr.No	Name	Designation
1	Dr. Avanish K. Srivastava	Director
2	Dr. R.K. Morchhale	Chief Scientist
3	Sh. A.K. Singh	Chief Scientist
4	Dr. S.A.R. Hashmi	Chief Scientist
5	Dr. D.P. Mondal	Chief Scientist
6	Dr. P. Asokan	Chief Scientist
7	Sh. R.S. Ahirwar	Sr. Principal Scientist
8	Dr. Manish Mudgal	Sr. Principal Scientist
9	Dr. J.P. Shukla	Sr. Principal Scientist
10	Dr. S. Murali	Sr. Principal Scientist
11	Dr. Deepti Mishra	Sr. Principal Scientist
12	Dr. Md. Akram Khan	Sr. Principal Scientist
13	Dr. Sanjeev Saxena	Sr. Principal Scientist
14	Sh. H.N. Bhargaw	Sr. Principal Scientist
15	Sh. S.K.S. Rathore	Sr. Principal Scientist
16	Dr. J.P. Chaurasia	Principal Scientist
17	Sh. R.K. Bharilya	Principal Scientist
18	Dr. Gaurav Kr.Gupta	Principal Scientist
19	Dr. Sathish N.	Principal Scientist
20	Dr. S.K. Panthi	Principal Scientist
21	Sh. Meraj Ahmed	Principal Scientist
22	Dr. Sarika Verma	Principal Scientist
23	Dr. Raju Khan	Principal Scientist
24	Dr. Archna Singh	Principal Scientist
25	Dr. Neeraj dwivedi	Principal Scientist

26	Sh. Prabhat Kumar Baghel	Principal Scientist
27	Sh. Satanand Misra	Sr. Scientist
28	Dr. Alka Mishra	Sr.Scientist
29	Sh. Abhishek Kr. Pandey	Sr. Scientist
30	Sh. Venkat A.N.	Sr.Scientist
31	Dr. Chetna Dhand	Sr. Scientist
32	Dr. Pradip Kumar	Sr. Scientist
33	Dr. Rajesh Patidar	Sr. Scientist
34	Shri Sriram Sathaiah	Scientist
35	Dr. Tilak Chandra Joshi	Scientist
36	Shri Mohammad Ashiq	Scientist
37	Dr. Surendra Kumar	Scientist
38	Dr. Mohit Sharma	Scientist
39	Shri Nikhil Rajendra Gorhe	Scientist
40	Dr. Manoj Kumar Gupta	Scientist
41	Dr. Shabi T.S.	Scientist
42	Ms. Medha Mili	Scientist
43	Shri Narendra Singh	Scientist
44	Shri Shiv Singh Patel	Scientist
45	Dr. Shiv Singh	Scientist

Technical Staff

Sr.No	Name	Designation
1	Sh. Ajay Kulshreshth	PrincipalTO
2	Sh. T.S.V.C. Rao	PrincipalTO
3	Sh. M.K. Ban	PrincipalTO
4	Dr. Ajay Naik	PrincipalTO
5	Sh. R.K. Soni	PrincipalTO
6	Dr. Edward Peters	PrincipalTO
7	Dr.(Mrs.)Sorna Gowri	Principal TO
8	Dr.(Mrs.)Prabha Padmakaran	Sr. TO
9	Smt. Sangeeta Gamad	Sr. TO
10	Sh. O.P. Chourasia	Sr. Tech. Officer
11	Sh. Anwar Ahmed Bakhsh	SE
12	Sh. Deepak Kr. Kashyap	Tech.Officer
13	Sh. Balwant Barkhania	Tech.Officer
14	Sh. Mohd. Shafeeq M	Tech.Officer
15	Sh. Anup Kr. Khare	Tech.Officer
16	Sh. K.K. Naktode	Tech.Officer
17	Sh. Prasanth N.	Tech.Officer
18	Sh. M.L. Gurjar	Sr. Tech
19	Sh. Akhtar Ullah	Sr. Tech
20	Sh. Abhay Yadav	Sr. Tech
21	Sh. Arvind Kr. Asati	Sr. Tech

22	Sh. S.K. Suryavanshi	Sr. Tech
23	Smt. Swagatika Pal	Sr. Tech
24	sh. Ramesh koluram	Tech. Gr. II
25	Sh. L.N. Sahu	Tech.Gr.I
26	Sh. Santosh.K. Batham	Tech.Gr.I
27	Sh. S.K. Raikwar	Tech.Gr.I
28	Sh N.S. Jadav	Tech.Gr.I
29	Sh. Anil Gond	Tech.Gr.I

Administrative Staff

Sr.No	Name	Designation
1	Sh.R.N. Waghmare	Administrative Officer
2	Sh. A.K. Jain	Administrative Officer
3	Sh. Dheeraj	Finance & Accts Officer
4	Shri P.M. Verma	Store & Purches Officer
5	Sh. Sanjay Vinodia	Finance & Accts Officer
6	Sh. P.K. Srivastava	Protocol Officer
7	Dr. Manisha Dubey	Senior Hindi Officer
8	Smt. Mini Surendran	Prinicpal Private Secretary
9	Sh. N. Viswanathan	Private Secretary
10	Smt. Asha Vinodia	Asstt. Section Officer(Gen)
11	Sh. Vijay K. Nathiley	Asstt. Section Officer(S&P)
12	Sh. Harihar Singh	Asstt. Section Officer(Gen)
13	Shri Neelesh Jaiswal	Asstt. Section Officer(Gen)
14	Sh. Shailendra Singh Tomar	Asstt. Section Officer(S&P)
15	Sh. Vijay K. Shrivastav	Asstt. Section Officer(F&A)
16	Smt. Anita Daniel	Receptonist

17	Sh. G. Adinarayan	Security Officer
18	Sh. Devtanand Prasad	Tea & Coffee Maker
19	Sourabh Sethia	Sr. Stenographer
20	Sh. Rahul Singh Chouhan	Senior Secretariat Assistant(S&P)
21	Sh. Praveen Kumar	Senior Secretariat Assistant (F&A)
22	Ms. Seema Bisht	Junior Secretariat Assistant(G.)
23	Smt. Trishala Rangari	Record Keeper
24	Sh. Dayaram	Safaiwala
25	Smt. Asha Golait	Peon

AMPRI IN NEWS AND MEDIA

उपलब्धि

वैज्ञानिक एवं औद्योगिक अनुसंधान परिषद की लैब एम्प्री ने तैयार किया विशेष सैनिटाइजर

सस्ता और सुरक्षित सैनिटाइजर का स्वदेशी फार्मूला हुआ तैयार

सौरभ खंडेलवाल • भोपाल

नवदुनिया विशेष

कोविड 19 के वायरस को मारने के लिए बड़े पैमाने पर सैनिटाइजर का उपयोग किया जा रहा है, लेकिन इसके ज्यादा इस्तेमाल से चमड़ी सूखने और फटने की शिकायतें भी आ रही हैं। लेकिन, वैज्ञानिक एवं औद्योगिक अनुसंधान परिषद (सीएसआइआर) के प्रगत पदार्थ व प्रक्रम अनुसंधान संस्थान (एम्प्री) ने इसकी भी काट निकाल ली है। एम्प्री के वैज्ञानिकों का दावा है कि उन्होंने ऐसा सैनिटाइजर बनाया है, जो न सिर्फ कोरोना को मारेगा बल्कि हाथ के अच्छे बैक्टीरिया और इसकी नमी को कम नहीं होने देगा।

(डॉ.) अवनीश कुमार श्रीवास्तव और उनकी टीम ने यह सैनिटाइजर बनाया है और इसका पेटेंट कराने की प्रक्रिया शुरू कर दी है। प्रो. श्रीवास्तव के मुताबिक विश्व स्वास्थ्य संगठन के दिशा-निर्देशों के तहत बने इस सैनिटाइजर में कुछ विशेष पदार्थों और तकनीक का उपयोग किया गया है, लेकिन इंटेलेक्चुअल प्रॉपर्टी का हिस्सा होने की वजह से इसे पेटेंट से पूर्व सार्वजनिक नहीं किया जा सकता। प्रो. श्रीवास्तव ने बताया कि इस सैनिटाइजर में ... का उपयोग भी किया गया है, जिससे स्किन ... होगी। इसके साथ ही घर की अन्य वस्तुएं जैसे टीवी, फ्रीज सहित अन्य सामान सैनिटाइज करने में भी इसका उपयोग कर सकते हैं।

डायरेक्टर प्रो. अवनीश कुमार श्रीवास्तव (कोट में), सीनियर प्रिंसिपल साइंटिस्ट डॉ. एसकेएस राठौर (सफेद शर्ट में) और साथी वैज्ञानिक। • नवदुनिया

बाजार में मिल रहे सैनिटाइजर से होगा किफायती

प्रो. श्रीवास्तव के मुताबिक यह सैनिटाइजर बाजार में अभी मिल रहे सैनिटाइजर के मुकाबले काफी किफायती भी साबित होगा, बशर्ते कोई कंपनी इस पर ज्यादा मुनाफा न कमाए। बाजार में अभी अच्छा सैनिटाइजर 200 से 250 रुपये में 250 मिलिलीटर मिलता है। उन्होंने बताया कि हमने किसी कंपनी का व्यावसायिक खर्च नहीं जोड़ा है, लेकिन अनुमान है कि एम्प्री के बनाए सैनिटाइजर की लागत 250 से 300 रुपये प्रति लीटर आएगी।

जीवन का हिस्सा बन जाएगा सैनिटाइजर

प्रो. अवनीश कुमार श्रीवास्तव के मुताबिक कोरोना के बाद भी सैनिटाइजर जीवन का अहम हिस्सा बन जाएगा। बच्चों और बूढ़ों को ज्यादा उपयोग करने से कोई दिक्कत न हो, इसलिए इस तरह का सैनिटाइजर बनाया गया है। एम्प्री ने इसका पेटेंट कराने की प्रक्रिया शुरू कर दी है। जो कंपनी चाहे, इसे बनाने के अधिकार खरीद सकती है।

ज्यादा उपयोग से कटती है स्किन

सैनिटाइजर में एल्कोहल होता है। इसके उपयोग से स्किन सूखती है। ज्यादा इस्तेमाल करने से स्किन फटती है और एग्जिमा का रूप ले सकती है। बचने के लिए ... नारियल तेल, गुलाब जल, ग्लीसरीन लगाएं। ... सैनिटाइजर को ... उतरने के बाद ही ...

-डॉ. ..., चर्म रोग विशेषज्ञ

पराली की प्लाई करेगी कमाल, चार गुना मजबूत भी होगी

पराली के सदुपयोग की नई तकनीक, दुनियाभर के आठ देशों से मिला पेटेंट

तितिकांत तिवारी • भोपाल

पराली की समस्या का एक बेहतर समाधान सामने आया है। पराली समेत गेहूं व सोयाबीन के भूसे से अब प्लाई बनेगी। इसे बनाने में पराली, भूसा या अन्य कृषि अपशिष्ट के अलावा 30 प्रतिशत पॉलिमर (रासायनिक पदार्थ) मिलाया जाएगा। भोपाल स्थित काउंसिल ऑफ साइंटिफिक एंड इंडस्ट्रियल रिसर्च (सीएसआइआर)-एम्प्री (एडवांस मटेरियल्स एंड प्रोसेस रिसर्च) ने तीन वर्षों के प्रयास के बाद यह तकनीक विकसित की है। शुक्रवार को इस तकनीक के जरिये उत्पादन शुरू करने का लाइसेंस भी छत्तीसगढ़ के भिलाई स्थित शुभ ग्रीन

औद्योगिक उत्पादन के लिए भिलाई की कंपनी को लाइसेंस, मार्च, 2021 से शुरू हो सकता है व्यावसायिक उत्पादन

शीट प्राइवेट लिमिटेड को दिया गया। कंपनी 10 करोड़ रुपये की लागत से मार्च, 2021 से उत्पादन शुरू करने की तैयारी में है।

एम्प्री के डायरेक्टर डॉ. अवनीश कुमार श्रीवास्तव का दावा है कि देश की यह पहली तकनीक है। इसे अमेरिका, कनाडा, चीन, फ्रांस, ऑस्ट्रेलिया, स्पेन समेत आठ देशों से पेटेंट मिल चुका है। कृषि अपशिष्ट से बनने वाली प्लाई वर्तमान बाजार में उपलब्ध प्लाई से चार गुना मजबूत और सस्ती होगी। करीब 20 वर्षों तक इसमें कोई खराबी नहीं आएगी।

रिसाइकल करने के बाद भी प्लाई ही बनेगी: यह तकनीक विकसित करने में अहम भूमिका निभाने वाले मुख्य विज्ञानी डॉ. असोकन पप्पू ने बताया कि पुरानी या खराब प्लाई को रिसाइकल कर फिर से वही उत्पाद बनाया सकता है। उन्होंने दावा किया कि इसमें आग, पानी, नमी, दीमक व फंगस का कोई असर नहीं होगा। इसे लैमिनेशन-युक्त और बिना लैमिनेशन वाले संस्करणों में उतारा जाएगा। डॉ. असोकन के मुताबिक मौजूदा स्थितियों के मुताबिक अलग-अलग गुणवत्ता की यह प्लाई बाजार में 26 से 46 रुपये प्रति वर्गफीट तक में मिल सकेगी। बाजार में उपलब्ध प्लाई का दाम इससे कम से कम 10 रुपये महंगा है।

हरियाणा की 80 प्रतिशत पराली की समस्या खत्म: इस तकनीक को लेकर एम्प्री द्वारा पिछले दिनों आयोजित एक वेबिनार में एनआइटी कुरुक्षेत्र के निदेशक प्रो. सतीश कुमार ने कहा कि इसका अधिकतम उपयोग हो तो पंजाब व हरियाणा में पराली जलाने से वहां और दिल्ली में होने वाले प्रदूषण से निजात मिल जाएगी। सीएसआइआर के महानिदेशक शेखर सी. मांडे ने कहा यह तकनीक देश के लिए आज की बड़ी जरूरत है। एम्प्री के निदेशक ने बताया कि पिछले वर्ष के अनुमानों के मुताबिक हरियाणा में प्लाई उत्पादन में इस तकनीक के उपयोग से वहां की 80 प्रतिशत पराली का उपयोग हो जाएगा।

शिक्षकों ने विज्ञान में हुए नवाचारों के बारे में जाना

भोपाल। प्रगत पदार्थ प्रक्रम अनुसंधान संस्थान (एम्प्री) में शिक्षकों को नवाचार के बारे में बताने के लिए कार्यशाला का आयोजन किया गया था। इसमें केंद्रीय विद्यालय, नवोदय विद्यालय समेत कुछ निजी स्कूलों के मिलाकर 250 शिक्षकों ने ऑनलाइन भाग लिया। दो दिवसीय कार्यशाला में शिक्षकों को विज्ञान में हुए नवचारों के बारे में बताया गया। समापन के दौरान एम्प्री के निदेशक अवनीश कुमार श्रीवास्तव ने कहा कि वैज्ञानिकों ने जो व्याख्यान दिए हैं, प्रयोगों के जरिए जिस तरह शिक्षकों को बताया वह ज्ञान अब शिक्षकों के माध्यम से बच्चों तक पहुंचेगा। इस दौरान मुख्य अतिथि मैनिट के प्राध्यापक डॉ. एचएल तिवारी ने शिक्षक की तारीफ की। (नभ)

सामग्री विज्ञान में नवाचार पर आज से कार्यशाला

मध्य स्वदेश, भोपाल।
बायोमेडिकल अनुप्रयोगों के लिए सामग्री विज्ञान में नवाचार विषय पर दो दिवसीय कार्यशाला का आयोजन आज से किया जा रहा है। 25 फरवरी तक चलने वाले इस कार्यक्रम का आयोजन एसईआरबी नई दिल्ली के तत्वाधान में सीएसआईआर एम्प्री द्वारा किया जा रहा है। वर्चुअल प्लेटफॉर्म के माध्यम से आयोजित इस कार्यशाला का उद्देश्य छात्रों, अनुसंधान विद्वानों और अंत:विषय अनुसंधान में रुचि रखने वाले संकायों को शिक्षित करने के लिए नैनोमटेरियल, बायोमटेरियल, जैव चिकित्सा विज्ञान के क्षेत्र में काम करने वाले प्रतिष्ठित वैज्ञानिकों और संकायों को एक ही मंच पर लाना है। कार्यशाला के दौरान प्रख्यात शोधकर्ता जैव चिकित्सा संबंधी अनुप्रयोगों से संबंधित विभिन्न विषयों पर व्याख्यान देंगे।

विद्यार्थियों को मिला विज्ञान प्रौद्योगिकी में नवाचार का ज्ञान

भोपाल। सीएसआईआर-एम्प्री भोपाल में विज्ञान और प्रौद्योगिकी के क्षेत्र में नवाचार विषय पर दो दिवसीय राष्ट्रीय विज्ञान शिक्षक कार्यशाला का समापन हो गया। विज्ञान प्रौद्योगिकी में नवाचार का ज्ञान यहां विभिन्न विद्यालयों के विद्यार्थीयों के साथ शिक्षकों के लिये लाभप्रद माना गया। संस्थान के निदेशक डॉ. अवनीश कुमार श्रीवास्तव ने अपने स्वागत उद्बोधन में यही जाहिर किया। यहां उनका कहना था कि हमारे वैज्ञानिक जो नवाचार किये हैं और अपने व्याख्यान और प्रयोग के प्रदर्शन में जो ज्ञान शिक्षकों को दिया है उनका सीधे लाभ छात्रों अर्थात भविष्य के वैज्ञानिक पर होगा। मुख्य अतिथि रहे मौलाना आजाद राष्ट्रीय प्रद्योगिकी संस्थान के प्राध्यापक डॉ. एच एल तिवारी ने अपने उद्बोधन में सीएसआईआर-जिज्ञासा के प्रोग्राम को विद्यालय स्तर पर वैज्ञानिक सोच पैदा करने का एक सही माध्यम बतलाया। कार्यक्रम के समन्वयक डॉ. सतानंद मिश्र ने बताया कि दो दिन के इस कार्यक्रम में कुल 12 सत्र हुए। जिसमे विभिन्न वैज्ञानिकों ने अपने शोध के माध्यम से नवाचार को प्रस्तुत किया।

एम्प्री में बायोमेडिकल पर दो दिवसीय कार्यशाला आज से

● लोक सिटी रिपोर्टर ●

सीएसआईआर एम्प्री में 24 और 25 फरवरी को वर्चुअल प्लेटफॉर्म में 'बायोमेडिकल अनुप्रयोगों के लिए सामग्री विज्ञान में नवाचार' विषय पर दो दिवसीय कार्यशाला का आयोजन किया जा रहा है। कार्यशाला एसईआरबी (भारत सरकार) नई दिल्ली द्वारा प्रायोजित है। कार्यशाला में छात्रों, अनुसंधान विद्वानों और अंतः विषय अनुसंधान में रुचि रखने वाले संकायों को शिक्षित करने के लिए नैनोमटेरियल, बायोमटेरियल, जैव चिकित्सा विज्ञान के क्षेत्र में काम करने वाले प्रतिष्ठित वैज्ञानिकों और संकायों को एक ही मंच पर लाना है। कार्यशाला का शुभारंभ निदेशक एम्प्री डॉ. अवनीश कुमार श्रीवास्तव के द्वारा किया जाएगा। इस अवसर पर तिरुवनंतपुरम के आरजीसीबी के निदेशक प्रो. चंद्रभास नारायण का व्याख्यान होगा। कार्यशाला के दौरान शोधकर्ता जैव चिकित्सा संबंधी अनुप्रयोगों से संबंधित विभिन्न विषयों पर व्याख्यान देंगे।

एम्प्री में बायोमेडिकल पर दो दिवसीय कार्यशाला आज से

● लोक सिटी रिपोर्टर ●

सीएसआईआर एम्प्री में 24 और 25 फरवरी को वर्चुअल प्लेटफॉर्म में 'बायोमेडिकल अनुप्रयोगों के लिए सामग्री विज्ञान में नवाचार' विषय पर दो दिवसीय कार्यशाला का आयोजन किया जा रहा है। कार्यशाला एसईआरबी (भारत सरकार) नई दिल्ली द्वारा प्रायोजित है। कार्यशाला में छात्रों, अनुसंधान विद्वानों और अंतः विषय अनुसंधान में रुचि रखने वाले संकायों को शिक्षित करने के लिए नैनोमटेरियल, बायोमटेरियल, जैव चिकित्सा विज्ञान के क्षेत्र में काम करने वाले प्रतिष्ठित वैज्ञानिकों और संकायों को एक ही मंच पर लाना है। कार्यशाला का शुभारंभ निदेशक एम्प्री डॉ. अवनीश कुमार श्रीवास्तव के द्वारा किया जाएगा। इस अवसर पर तिरुवनंतपुरम के आरजीसीबी के निदेशक प्रो. चंद्रभास नारायण का व्याख्यान होगा। कार्यशाला के दौरान शोधकर्ता जैव चिकित्सा संबंधी अनुप्रयोगों से संबंधित विभिन्न विषयों पर व्याख्यान देंगे।

इनोवेशन@एम्प्री

बायोसेंसर से 10 मिनट में पता चलेगा कोरोना पॉजिटिव हैं या निगेटिव

एम्प्री में बायो मेडिकल इनोवेशंस पर चल रही दो दिवसीय वर्कशॉप का समापन

सिटी रिपोर्टर| कोरोना पॉजिटिव हो गए या सेफ हैं... यह पता लगाने के लिए फिलहाल आरटीपीसीआर टेस्ट होता है, जिसका रिजल्ट आने में करीब एक से डेढ़ दिन इंतजार करना पड़ता है,

लेकिन इन दिनों सीएसआईआर-एम्प्री भोपाल के डॉ. राजू खान नैनो पार्टिकल्स पर काम कर रहे हैं, जिससे तैयार होने वाले बायोसेंसर की मदद से कोरोना का आरटीपीसीआर जितना एक्यूरेट टेस्ट सिर्फ 5 से 10 मिनट में हो जाएगा। ऐसे ही बायो मेडिकल साइंस से जुड़े कुछ लेटेस्ट इनोवेशन पर देशभर के रिसर्चर्स और वैज्ञानिकों ने गुरुवार को चर्चा की। मौका था, एम्प्री भोपाल की ओर से आयोजित दो दिवसीय वर्कशॉप का। इस अवसर पर आईआईटी नई दिल्ली के प्रोफेसर जेपी सिंह ने नैनो रॉड्स से ऐसे सब्सट्रेट बनाने के बारे में बताया, जिससे एचआईवी समेत बैक्टीरिया, डेंगू जैसे वायरस की जांच सस्ती और जल्दी की जा सकेगी।

बायोडॉट्स से पता चल सकेगा, फल-सब्जी केमिकल से तो नहीं पकाए गए

जेएनयू की डॉ. प्रतिभा सोलंकी ने कार्बन डॉट्स पर अपना प्रेजेंटेशन दिया। उन्होंने बताया कि बायोडॉट्स का इस्तेमाल अभी तक केवल सेल्स की स्टडी के लिए किया जाता था, लेकिन अब इन सेंसर्स का उपयोग फूड आइटम्स में पेस्टिसाइड्स और टॉक्सिंस को डिटेक्ट करने में किया जा रहा है। इसके नए एप्लीकेशन पर डिवाइस तैयार की जा रही है, जिसमें फल या सब्जी का जूस डिवाइस में डालते ही बता देगा कि पेस्टिसाइड या केमिकल से तो नहीं पकाया गया। वहीं, सीएसआईआर-एनपीएल दिल्ली के प्रमुख वैज्ञानिक डॉ. बिपिन गुप्ता ने बाईफंक्शनल प्रोब्स के जैविक उपयोग के बारे में बताया।

राष्ट्रीय विज्ञान शिक्षक की दो दिवसीय कार्यशाला शुरू

भोपाल। विज्ञान एवं प्रौद्योगिकी में नवाचार विषय पर दो दिवसीय राष्ट्रीय विज्ञान शिक्षक कार्यशाला का शुभारम्भ आज से हुआ। सीएसआईआर-एम्प्री भोपाल द्वारा आयोजित सीएसआईआर जिज्ञासा के अंतर्गत इस बार विषय विज्ञान और प्रौद्योगिकी के क्षेत्र में नवाचार लिया गया है। संस्थाा के निदेशक डॉ अवनीश कुमार श्रीवास्तव ने अपने उद्घाटन भाषण में विज्ञान एवं प्रोद्योगिकी के क्षेत्र में विकसित कोविड-19 के प्रसार को रोकने के लिए उन्नत ग्रेफीन मास्क, सैनिटाइजर और यूवी किरणों कीटाणुनाशक बक्से के बारे में जानकारी दी है। मुख्य अतिथि डॉ. दीपा श्रीनिवासन द्वारा गैस टर्बाइन और विमान इंजीनियरिंग में धातु विज्ञान, 3डी प्रिंटिंग एवं योगात्मक विनिर्माण आधारित अनुसंधानो पर प्रकाश डाला। उन्होंने ऑनलाइन प्लेटफार्मों पर महामारी की कठिनाइयों के बावजूद सीखने की प्रक्रिया को जारी रखने के लिए किए गए प्रयासों की सराहना की। डॉ वरिष्ठ वैज्ञानिक सतानंद मिश्र ने जिज्ञासा प्रोग्राम ने दो दिन तक चलने वाले कार्यक्रम के संबंध में कहा कि सन 2017 में 30 शिक्षकों के साथ शुरू विज्ञान शिक्षक कार्यशाला की सफलता इसी से समझी जा सकती है कि चौथे साल इसमें 250 शिक्षक भाग

वेबीनार — दो दिवसीय सेमीनार में विद्वानों ने कहा...

इमारती लकड़ी के संरक्षण में सहायक है बांस

मध्य स्वदेश संवाददाता ■ भोपाल

इमारती लकड़ी एवं पर्यावरण का संरक्षण में बांस सहायक है। इससे लोगों को रोजगार के नये अवसर बनेंगे। यह कहना है परमाली वालेस के मिहिर मर्चेंट का।

वह विश्व बांस दिवस पर के अवसर पर बैम्बू टेक्नोलॉजीज फॉर सस्टेनेबल लाइवलीहुड विषय पर दो दिवसीय वेबिनार के अंतिम दिन बोल रहे थे। सीएसआइआर-एम्प्री, भोपाल द्वारा आयोजित इस कार्यक्रम विकसित बम्बू कम्पोजिट को बड़े पैमाने पर उत्पादन की आवश्यकता पर जोर दिया गया। इस अवसर पर एम्प्री के निदेशक डॉ अवनीश कुमार और हिमालयन जैव-संसाधन प्रौद्योगिकी संस्थान, पालमपुर हिमाचल प्रदेश के मुख्य वैज्ञानिक केके सिंह ने भी संबोधित किया। डॉ श्रीवास्तव ने यहां कहा कि जीवन की गुणवत्ता पर विशेष ध्यान के साथ बांस और बांस आधारित उत्पादों की खोज के लिए अनुसंधान को फिर से उन्मुख होना चाहिए। अनुसन्धान और उद्योग के पास हाथ मिलाने और लोगों की आकांक्षा को पूरा करने का यह सुनहरा अवसर है। यहां उन्होंने शोधकर्ताओं के प्रयासों की सराहना करते हुए कहा कि यह भारत को अनुसन्धान एवं विकास के विश्व पटल पर स्थान दिलाने में अपना महत्वपूर्ण योगदान दे रहे हैं।

इतना ही नहीं बांस आधारित अर्थव्यवस्था की कल्पना के लिए उच्च गुणवत्ता वाले बाँस के व्यापक उत्पादन की नितांत आवश्यकता है। बेहतर किस्म के बाँस का चयन और बड़े पैमाने पर खेती, टिकाऊ विकास के लिए वर्तमान समय की आवश्यकता है। इस दौरान वरिष्ठ प्रधान वैज्ञानिक एम्प्री भोपाल डॉ. संजीव सक्सेना ने बांस मिश्रित संरचनाओं को जोड़ने की तकनीक और मुल्यांकन पर विस्तृत अध्ययन प्रस्तुत किया। वहीं मैसर्स पर्माली वालेस के डॉ. भुजंग सेठ ने हाल ही में विकसित बांस मिश्रित और उच्च यांत्रिक शक्ति वाले विद्युत इन्सुलेशन सहित विभिन्न अनुप्रयोगों में इसकी क्षमता का विवरण प्रस्तुत किया। वहीं दूसरी ओर सहारनपुर की डॉ प्रीति शिवहरे लाल ने लुगदी प्रक्रिया के माध्यम से बांस आधारित कागजों के बारे में जानकारी दी गई। एम्प्री भोपाल की प्रधान वैज्ञानिक डॉ. सारिका वर्मा एवं श्रीमती मेधा मिली ने लिग्नोसेलुलोसिक सामग्री पर आधारित नई कंपोजिट और उनकी भविष्य की क्षमता को प्रस्तुत किया है।

एम्प्री का दौरा करेंगे डॉ.हर्षवर्धन

भोपाल। केन्द्रीय विज्ञान एवं प्रौद्योगिकी मंत्री डॉ.हर्षवर्धन आज सीएसआईआर-एम्प्री का दौरा करेंगे। संस्थान के निदेशक डॉ. अवनीश कुमार श्रीवास्तव ने बताया कि संस्थान भ्रमण के दौरान वह उन्नत विकिरण कवच एवं जियोपॉलीमेरिक पदार्थ केंद्र तथा विश्लेषणात्मक उच्च रिजॉल्यूशन ट्रांसमिशन इलेक्ट्रॉन माइक्रोस्कोप प्रयोगशाला का उद्घाटन करेंगे और फ्लाई ऐश कम्पेडियम का विमोचन करेंगे। वह यहां सीएसआईआर-एम्प्री में बाँस कम्पोजिट स्ट्रक्चर 'बैठक' की आधारशिला भी रखेंगे। इसके बाद प्रौद्योगिकी प्रदर्शनी का अवलोकन करेंगे।

TRIPURA OBSERVER

PREMIER ENGLISH DAILY OF TRIPURA

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The delegation of scientists from CSIR-AMPRI, Bhopal in a group photo with the Deputy Chief Minister Jishnu Dev Varma and Director of Science, Technology and Environment department Tanusree Debbarma during a workshop on 'Bamboo and Bamboo Wood for Industrial and Domestic Applications' at Pragna Bhavan, Agartala on Monday.

Asks UP opposition leader
Why Covid-19 vaccine is not free for public

Pratima assures help to fire tragedy victim

PMGSY: Access payments, works undone
'Govt to file arbitration against HSCL in MoRD'

Sonkar to meet Barman's team today

2 farmers from Khowai held in B'desh while smuggling drugs

शहर में हो रहे पानी से इंडस्ट्रियल डाई हटाने, गाड़ियों को हाइब्रिड बनाने और पराली से फर्नीचर बनाने जैसे रिसर्च

दुनिया के टॉप 2% वैज्ञानिकों में शामिल भोपाल से 11 साइंटिस्ट

गर्व की बात

सिटी रिपोर्टर। अमेरिका की स्टैनफोर्ड यूनिवर्सिटी ने विज्ञान के सभी क्षेत्रों के दुनिया के टॉप-2 प्रतिशत वैज्ञानिकों की सूची जारी की है। खास बात यह है कि इस सूची में भोपाल के 11 वैज्ञानिक शामिल हैं। इनमें 3 मैनिट से, 3 आईसर से, 1 एनआईटीटीटीआर से और 4 वैज्ञानिक सीएसआईआर-एम्प्री से हैं।

- **आलोक मित्तल,** मैनिट वर्ल्ड रैंक - 638 रिसर्च पेपर - 550, साइटेशंस - 11000+

पानी में इंडस्ट्रियल वेस्ट के तौर पर घुलने वाली डाई यानी रंगों को पानी से वापस निकालने पर रिसर्च की है। पानी से रंग को अवशोषित (एडजॉर्प) करने वाले चार नए अवशोषक (एडजॉर्पेंट) खोज, जो सोसायटी में वेस्ट की तरह देखे जा रहे हैं। इनमें बॉटम ऐश और डी-ऑयल्ड सोया के अलावा मुर्गे के पंख, एग शेल और मेम्ब्रेन पर रिसर्च की है।

- **अवनीश श्रीवास्तव,** सीएसआईआर-एम्प्री, रैंक : 4400 रिसर्च पेपर : 250, साइटेशंस - 4900+

एडवांस्ड और नैनो मटेरियल्स पर बीते 30 सालों से काम कर रहे हैं। अवनीश ने इलेक्ट्रॉन हाई रिजॉल्यूशन माइक्रोस्कोपी पर रिसर्च की, जिससे किसी भी चीज के अणुओं को भी देखा जा सकता है। पराली बर्निंग की समस्या से निपटने के लिए पराली का इस्तेमाल कर प्लाईवुड तैयार किया, जिससे इसका इस्तेमाल ऑफिस फर्नीचर और लड़की के तौर पर किया जा सकता है।

ये भी हैं शामिल — मैनिट के ओपी मोदी, शैलेन्द्र जैन, आईसर भोपाल से कंकन भट्टाचार्या, दीपक चोपड़ा, नितिन टी पाटिल, सीएसआईआर-एम्प्री से डॉ. एस दास, बीके प्रसाद, नवीन चंद्रा और एनआईटीटीटीआर से स्व. पदमाकर वी खड़ीकर शामिल हैं।

तकनीक | प्रदूषण की बड़ी वजह नरवाई (पराली) के सदुपयोग की नई तकनीक, आठ देशों से मिला पेटेंट

धान तो धान, अब नरवाई की प्लाई से भी होगी कमाई

शशिकांत तिवारी ● भोपाल

- औद्योगिक उत्पादन के लिए भिलाई की कंपनी को लाइसेंस
- सामान्य से चौथाई लागत में चार गुना मजबूती का दावा

नरवाई या पराली की समस्या का एक बेहतर समाधान सामने आया है। नरवाई, गेहूं व सोयाबीन के भूसे से अब प्लाई बनाई जा सकेगी। इसे बनाने में कच्चे माल के तौर पर नरवाई, भूसा या अन्य कृषि अपशिष्ट का 70 फीसद हिस्सा और 30 फीसद पॉलीमर (रासायनिक पदार्थ) मिलाया जाएगा। भोपाल स्थित काउंसिल ऑफ साइंटिफिक एंड इंडस्ट्रियल रिसर्च (सीएसआइआर)-एम्प्री (एडवांस मटेरियल्स एंड प्रोसेस रिसर्च) ने तीन साल के प्रयास के बाद यह तकनीक विकसित की है। शुक्रवार को इस तकनीक के जरिये उत्पादन शुरू करने का लाइसेंस भी छत्तीसगढ़ के भिलाई स्थित शुभ ग्रीन शीट प्रा.लि. कंपनी को

एम्प्री के डायरेक्टर डॉ. अवनीश श्रीवास्तव।

पराली से तैयार प्लाई से बनाया गया फर्नीचर। ● सौजन्य : एम्प्री

लागत से मार्च, 2021 से उत्पादन शुरू करने की तैयारी में है।

एम्प्री के डायरेक्टर डॉ. अवनीश कुमार श्रीवास्तव का दावा है कि उनकी जानकारी में देश की यह पहली तकनीक है। इसे यूएसए, कनाडा, चीन, फ्रांस, ऑस्ट्रेलिया, स्पेन समेत आठ देशों से पेटेंट मिल चुका है। कृषि अपशिष्ट से बनने वाली प्लाई बाजार में उपलब्ध प्लाई सस्ती भी पड़ेगी। करीब 20 साल तक इसमें कोई खराबी नहीं आएगी।

उन्होंने कहा कि इस तकनीक से कच्चा माल व मजबूती देने वाले तत्व अलग-अलग मात्रा में मिलाकर अलग दबाव में विभिन्न गुणवत्ता की प्लाई तैयार की जा सकेगी। यह तकनीक विकसित करने में अहम भूमिका निभाने वाले मुख्य वैज्ञानिक डॉ. अशोकन पप्पू ने बताया कि

इस तरह बनाई जाती है प्लाई

वैज्ञानिक डॉ. अशोकन पप्पू बताते हैं प्लाई बनाने के लिए पहले कृषि अपशिष्ट से नमी व धूल अलग की जाती है। इसके बाद अन्य कच्चा माल मिलाकर एक निश्चित तापमान और दबाव में प्लाई बनाई जाती है।

हरियाणा की 80 फीसद पराली खप जाएगी

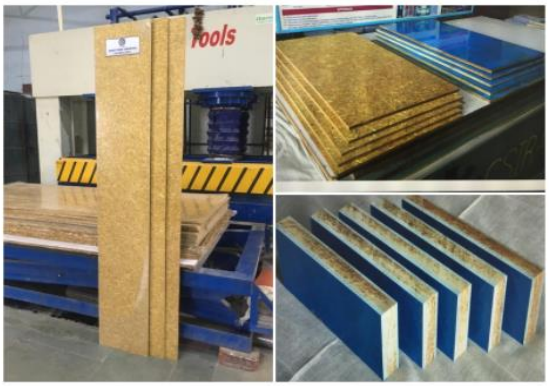
इस तकनीक को लेकर एम्प्री द्वारा शुक्रवार को आयोजित एक वेबिनार में एनआइटी कुरुक्षेत्र के निदेशक प्रो. सतीश कुमार ने कहा कि इसका अधिकतम उपयोग हो तो पंजाब व हरियाणा में पराली जलाने से वहां और दिल्ली में होने वाले प्रदूषण से निजात मिल जाएगी। सीएसआइआर के महानिदेशक शेखर सी. मांडे ने कहा यह तकनीक देश के लिए आज की बड़ी जरूरत है। एम्प्री के निदेशक डॉ.अवनीश कुमार श्रीवास्तव ने बताया कि उन्होंने पिछले साल एक अनुमान लगाया था कि हरियाणा में बनने वाली पूरी प्लाई इस तकनीक से बनाई जाए तो 80 फीसद पराली इसमें खप जाएगी। एम्प्री के सीनियर प्रिंसिपल वैज्ञानिक डॉ. एसपैदयस राठौर ने कहा कि

होम / मध्यप्रदेश / भोपाल

नरवाई या पराली की समस्या का अब बेहतर समाधान, हो सकता है ऐसा

प्रदूषण की बड़ी वजह नरवाई (पराली) के सदुपयोग की नई तकनीक, आठ देशों से मिला पेटेंटनरवाई की प्लाई करेगी कमाल, चार गुना मजबूती का दावा।

Updated: | Sun, 18 Oct 2020 05:53 AM (IST)



शशिकांत तिवारी, भोपाल। नईदुनिया। नरवाई या पराली की समस्या का एक बेहतर समाधान सामने आया है। नरवाई, गेहूं व सोयाबीन के भूसे से अब प्लाई बनाई जा सकेगी। इसे बनाने में कच्चे माल के तौर पर नरवाई, भूसा या अन्य कृषि अपशिष्ट का 70 फीसद हिस्सा और 30 फीसद पॉलीमर (रासायनिक पदार्थ) मिलाया जाएगा। भोपाल स्थित काउंसिल ऑफ साइंटिफिक एंड इंडस्ट्रियल रिसर्च (सीएसआइआर)-एम्प्री (एडवांस मटेरियल्स एंड प्रोसेस रिसर्च) ने तीन साल के प्रयास के बाद यह तकनीक विकसित की है।

शुक्रवार को इस तकनीक के जरिये उत्पादन शुरू करने का लाइसेंस भी छत्तीसगढ़ के भिलाई स्थित शुभ ग्रीन शीट प्रा.लि. कंपनी को दिया गया। कंपनी 10 करोड़ रुपये की लागत से मार्च, 2021 से उत्पादन शुरू करने की तैयारी में है।

Wood substitute from agro-industrial waste

By India Science Wire

New Delhi, Friday, October 23, 2020

India, the second largest agro-based economy with year-round crop cultivation, generates a large volume of agricultural waste; including crop residues. Crop-residue has emerged as a threat to the environment. The burning of crop residue in Punjab and Haryana is responsible for severe air pollution during winter in Delhi and Northern India. Various ways have been thought of and used to tackle the agro waste in an eco-friendly manner.

The Council of Scientific and Industrial Research-Advanced Materials and Processes Research Institute (CSIR-AMPRI), Bhopal conducted a research to find a productive way to manage the agro-industrial waste. The findings of the research paved way to introduce new materials for the development of a wood substitute for building applications so that consumption of timber in building and house construction can be minimised. This technology also offers a potential solution for

ENVIRONMENT

How construction material derived from agro-waste can pave way for sustainable living

Agro-based biocomposites help in carbon sequestration, control air pollution and reduce global warming

NEXT BLOG >

By Richa Singh
Published: Monday 22 February 2021

India generates 500 million tonnes of crop residue annually, according to the Union Ministry of New and Renewable Energy. Crop residue is typically used as fodder and fuel for domestic and industrial purposes. A surplus of 140 million tonnes, however, reportedly remains unattended, out of which 92 million tonnes is burnt each year.

Burning crop residue causes severe environmental hazards such as greenhouse gas emissions that contribute to global warming, increased particulate matter and smog that lead to health hazards and loss of biodiversity.

Crop residue burning significantly increases concentration of air pollutants such as that of carbon dioxide, carbon monoxide, ammonia and oxides of nitrogen, sulphur, volatile organic compounds and particulate matter (PM). Studies have speculated that these emissions can increase by 45 per cent in 2050 if existing practices continue

छत्तीसगढ़ मॉडल से पराली देगी खासी कमाई

ऋतुपर्ण दवे|

पराली को लेकर आधे अक्टूबर से दिसंबर और जनवरी के शुरू तक बेहद हो हल्ला होता है। व्यापक स्तर पर चिन्ता की जाती है, किसानों पर दण्ड की कार्रवाई की जाती है। बावजूद इसके समस्या जस की तस रही आती है। सच तो यह है कि जिस पराली को बोझ समझा जाता है वह बहुत बड़ा वरदान है। अच्छी खासी कमाई का जरिया भी बन सकती है बशर्ते उसकी खूबियों को समझना होगा।

लेकिन कहते हैं न हीरा तब तक पत्थर ही समझा जाता है जब तक कि उसे तराशा न जाए। पराली के भी ऐसे ही अनेकों फायदे हैं। न केवल उन्हीं खेतों के लिए यह वरदान भी हो सकती है बल्कि पशुओं के लिए तो सनातन से खुराक ही है। इसके अलावा पराली के वो संभावित उपयोग हो सकते हैं जिससे देश में एक नया और बड़ा भारी उद्योग भी खड़ा हो सकता है जिसकी शुरुआत हो चुकी है। इसके लिए जरूरत है सरकारों, जनप्रतिनिधियों, नौकरशाहों, वैज्ञानिकों, किसानों और बाजार के बीच जल्द से जल्द समन्वय की और खेतों में ठूठ के रूप में जलाकर नष्ट की जाने वाली पराली जिसे अलग-अलग रूप और नाम में पुआल, नरवारी, पैरा और भूसा भी कहते हैं जो सोने की कीमतों जैसे उछाल मारेगी।

Manoj Gupta gets CSIR Young Scientist Award

BHOPAL: Manoj Kumar Gupta, a scientist with the Advanced Materials and Processes Research Institute (AMPRI), Bhopal, has been selected for the prestigious CSIR Young Scientist Award in the physical sciences (including instrumentation) 2020. He is selected for the award for his work on developing the novel and innovative piezoelectric, piezoelectric and turboelectric nanogenerator as new class of renewable energy devices that generate electricity from tiny mechanical vibration and development of electrical insulating sheet from industrial wastes such as fly ash, marble, stone waste and other particulates. In this regard, Council of Scientific and Industrial Research (CSIR) has issued citation for his outstanding work. He is associated with Advanced Construction Materials Division of CSIR-AMPRI, Bhopal.

Gupta said he owed his achievement to CSIR-AMPRI, director Professor Avanish Kumar Srivastava and his colleagues. The award will be presented on the occasion of CSIR Foundation Day on September 26. The CSIR Young Scientist Award is given to those who are under 35 years for their excellent work.

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गुप्ता को सीएसआईआर यंग साइंटिस्ट अवार्ड

By **admin** - July 31, 2020 16 0

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भोपाल। भौतिकी एवं मैटेरियल्स विज्ञान में उत्कृष्ट योगदान के लिए, प्रगत पदार्थ तथा प्रक्रम अनुप्रगत पदार्थ तथा प्रक्रम अनुसंधान संस्थान (एम्प्री) भोपाल के वैज्ञानिक डॉ मनोज कुमार गुप्ता (एम्प्री) भोपाल के वैज्ञानिक डॉ मनोज कुमार गुप्ता को भौतिक विज्ञान (इन्स्ट्रमेंटेशन सहित) के क्षेत्र में प्रतिष्ठित सीएसआईआर यंग साइंटिस्ट अवार्ड-2020 के लिए चुना गया है। डॉ. गुप्ता को यह पुरस्कार पीजोइलेक्ट्रिक, पायरोइलेक्ट्रिक और ट्राइबोइलेक्ट्रिक नैनो-जनरेटर तकनीक के खोज और उसके विकास में उत्कृष्ट योगदान के लिए चुना गया है। नैनो-जनरेटर, अक्षय ऊर्जा की एक विशिष्ट तकनीक है जो यांत्रिक कंपन के द्वारा बिजली पैदा करती हैं। यह राष्ट्रीय पुरस्कार डॉ. गुप्ता को फ्लाई ऐश, मार्बल, स्टोन जैसे औद्योगिक अपशिष्टों से विद्युत इन्सुलेटिंग शीट के प्रोडक्ट्स बनाने के लिए भी दिया जा रहा है। इस संबंध में, "वैज्ञानिक और औद्योगिक अनुसंधान परिषद (सीएसआईआर)" ने इनके उत्कृष्ट कार्यों के लिए प्रशस्ति पत्र जारी किया है। डॉ. गुप्ता सीएसआई आर – एम्प्री, भोपाल में एडवांस्ड कंस्ट्रक्शन मटेरियल डिवीजन में कार्यरत हैं। यह पुरस्कार 26 सितंबर, 2020 को सीएसआईआर के स्थापना दिवस के अवसर पर प्रदान किया जाएगा। सीएसआईआर युवा वैज्ञानिक पुरस्कार उत्कृष्ट कार्य के लिए उन वैज्ञानिकों को दिया जाता है जिनकी आयु 35 वर्ष से कम होती हैं। इस अवसर पर, 50,000 नकद, 25 लाख अनुसंधान अनुदान और एक प्रशस्ति पत्र दिया जाता है। सीएसआईआर- एम्प्री, भोपाल के निदेशक डॉ. अवनीश कुमार श्रीवास्तव ने अपनी ख़ुशी व्यक्त करते हुए कहा कि यह राष्ट्रीय पुरस्कार डॉ. गुप्ता के लिए तो है ही साथ ही यह हमारे संस्थान के लिए भी एक बड़ा गौरव एवं उपलब्धि है।

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मंत्री

मनोज गुप्ता को सीएसआईआर यंग साइंटिस्ट अवार्ड

भोपाल। भौतिकी एवं मैटेरियल्स विज्ञान में उत्कृष्ट योगदान के लिए, प्रगत पदार्थ तथा प्रक्रम अनुसंधान संस्थान (एम्प्री) भोपाल के वैज्ञानिक डॉ. मनोज कुमार गुप्ता को भौतिक विज्ञान (इन्स्ट्रमेंटेशन सहित) के क्षेत्र में प्रतिष्ठित सीएसआईआर यंग साइंटिस्ट अवार्ड-2020 के लिए चुना गया है। डॉ. गुप्ता को यह पुरस्कार पीजोइलेक्ट्रिक, पायरोइलेक्ट्रिक और ट्राइबोइलेक्ट्रिक नैनो-जनरेटर तकनीक के खोज और उसके विकास में उत्कृष्ट योगदान के लिए चुना गया है।

संक्रमण काल में कड़ा इम्तिहान

...क्योंकि अस्पतालों में कतारें, कॉलेजों में ऑफलाइन परीक्षाएं, स्कूलों में बच्चों की भीड़

हमीदिया अस्पताल कोविड ब्लॉक के मेन गेट पर ही बना दी फीवर क्लीनिक जांच कराने आए लोगों के पास से ही गुजर रहे पॉजिटिव

स्कूल : 10वीं-12वीं के 75% से ज्यादा स्टूडेंट पहुंच रहे, इन्हें कोरोना के संक्रमण से बचाना बड़ी चुनौती

वीयू : यहां अप्रैल में 2.25 लाख स्टूडेंट पेन-पेपर मोड से देंगे परीक्षा

मॉडल सीबीआरआई रुड़की और एम्प्री भोपाल ने विकसित की तकनीक, कोरोना मरीजों के इलाज में मिलेगी मदद

48 घंटे में तैयार होगा आग, पानी व तूफान से सुरक्षित अस्पताल

भोपाल (नवदुनिया प्रतिनिधि)। राजधानी के प्रगत पवार्थ प्रक्रम अनुसंधान संस्थान और रुड़की के सेंट्रल बिल्डिंग रिसर्च इंस्टीट्यूट ने कोविड-19 के लिए कुछ घंटों में तैयार किए जाने वाले अस्पताल का मॉडल तैयार किया है। दोनों संस्थान केंद्रीय औद्योगिक अनुसंधान परिषद (सीएसआइआर) के अधीन हैं। इसका स्ट्रक्चर एल्युमीनियम से बना होगा। इसे मोड़ा जा सकेगा। यह एक मंजिला होगा। सीएसआइआर एम्प्री और सीबीआरआई रुड़की ने मिलकर अस्पताल, आवास और अन्य संरचना

यह फोल्डेबल अस्पताल का मॉडल। बनने के बाद ऐसा दिखेगा। -नवदुनिया

यह है तकनीक : एल्युमीनियम के पाइप का होगा उपयोग

इस तकनीक में हल्के पूर्व निर्मित एल्युमीनियम के पाइप का उपयोग किया जाता है। यह एक लॉक्ड होते हैं और लगाने में आसान हैं। साथ ही इसका कई बार उपयोग किया जा सकता है। यह तूफान, आग और पानी से पूरी तरह सुरक्षित है। किसी भी मौसम में इसका उपयोग किया जा सकता है। इस पर जिस कपड़े का इस्तेमाल किया जाएगा, उसमें एयर वेक्स होंगे। जिससे हर मौसम के अनुसार इसका वातावरण रहेगा। यह ठंडी में गर्म और गर्मी में ठंडा रहेगा। ज्यादा गर्मी होने पर इसमें एयर कंडिशनर भी लगाया जा सकेगा। इसकी लागत भी शुरुआत में चार से पांच सौ रुपये वर्गफीट आ रही है। यह लागत एक बार ही लगानी होगी।

के अस्पताल बनाए जा सकेंगे। यह आग, पानी और तूफान से पूरी तरह सुरक्षित रहेंगे। जरूरत खत्म होने पर इसे फोल्ड कर एक स्थान से दूसरे स्थान पर

सोमवार को एम्प्री भोपाल और सीबीआरआई रुड़की ने इस तकनीक को लांच किया। इस अवसर पर एम्प्री भोपाल के निदेशक डॉ. अवनीश श्रीवास्तव ने

जगह नहीं बचो है। चलाचल जगह भर गई हैं। ऐसे में इस तकनीक के जरिए किसी भी बड़े खुले मैदान में क्वारंटाइन सेंटर बनाया जा सकेगा। काम होने

निर्माण में मदद करेगी।

सीबीआरआई रुड़की के डायरेक्टर डॉ. एन गोपालाकृष्णन ने बताया कि विकसित तकनीक राष्ट्रीय और अंतरराष्ट्रीय मानकों के अनुरूप है। इसका उपयोग बेहद कम समय में प्रभावित क्षेत्रों में किया जा सकता है। सुरक्षा सीमाओं पर भी इसका उपयोग किया जा सकता है। इस अवसर पर मप्र विज्ञान एवं प्रौद्योगिकी परिषद के डायरेक्टर जनरल डॉ. अनिल कोठारी ने कहा कि इस प्रौद्योगिकी के उपयोग से प्रदेश की कई समस्याओं का निवारण