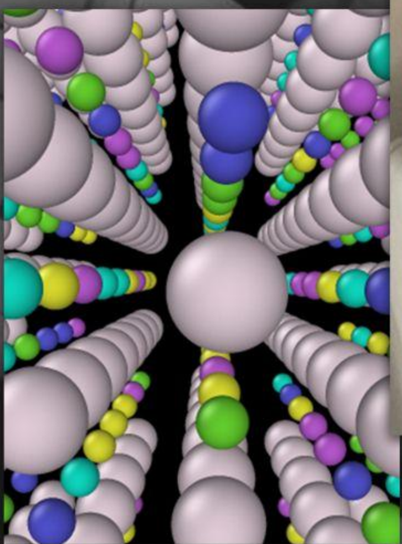
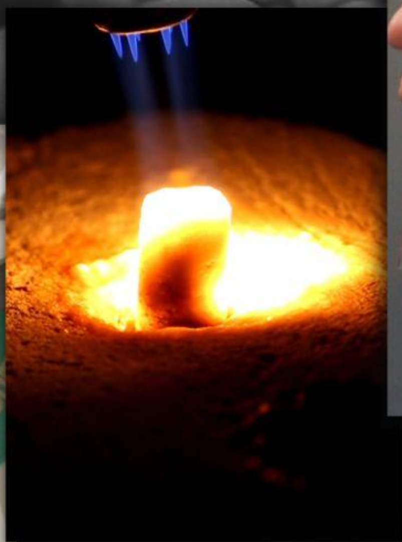
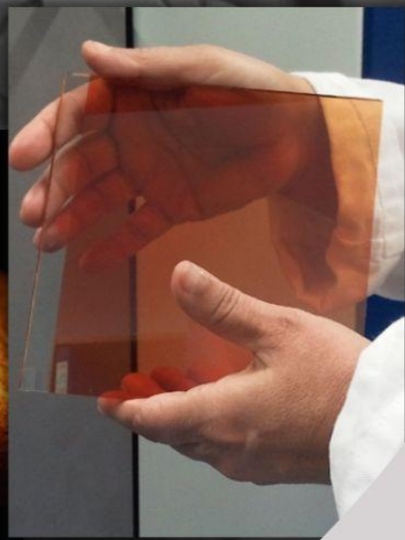
CERAMIC TECHNOLOGIES FOR FUTURISTIC MOBILITY

Intelligent Design of Ceramics from Electronic Structures to Fabrication







PROGRESS REPORT

2021-22

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CENTER OF EXCELLENCE

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CERAMIC TECHNOLOGIES FOR FUTURISTIC MOBILITY

CERAMIC TECHNOLOGIES FOR FUTURISTIC MOBILITY

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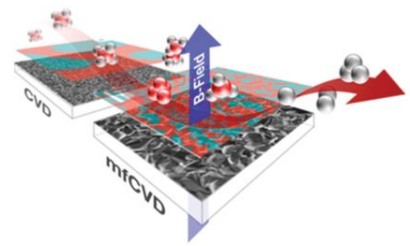
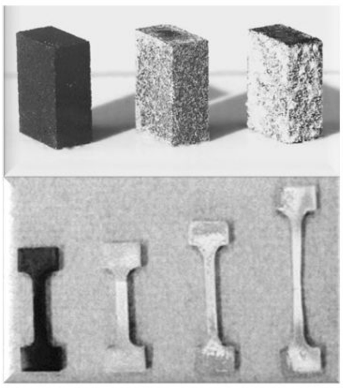
DOMAIN I



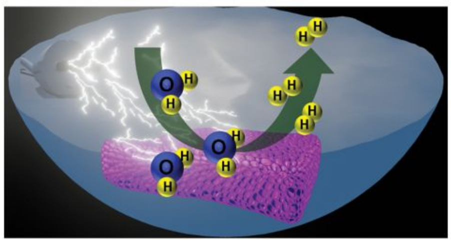
MICRO-/ NANOSTRUCTURED CERAMICS & COATINGS

DOMAIN II



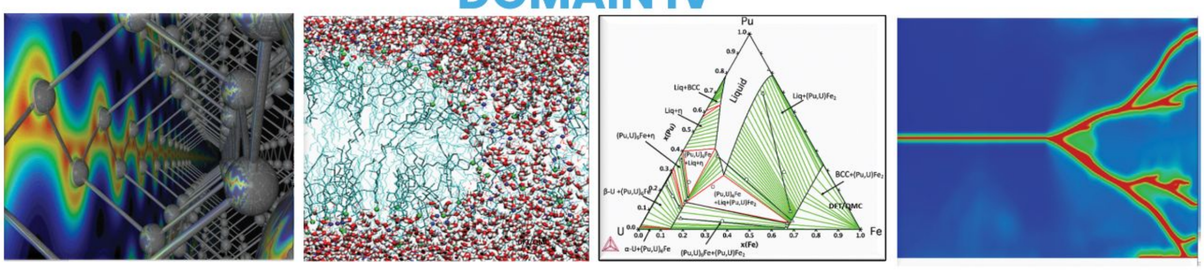
STRUCTURAL CERAMICS & COMPOSITES

DOMAIN III



FUNCTIONAL CERAMICS FOR ENERGY & ENVIRONMENT

DOMAIN IV



COMPUTATIONAL TECHNIQUES & DATA-DRIVEN DESIGN

SELECTED RESEARCH OUTCOMES

Numerical interpretation and experimental investigation of enhanced magnetoelectric effect in Ni/PZT distributed disc structured composite

HIGHLIGHTS

- Using prestress for multifold enhancement of ME response in novel DDS composites.
- Ability of in-series DDS configuration to operate as multi ME composite structures.
- Determination of optimum orientation of DDS composites in external magnetic field.
- Numerical modeling of interference fit and magnetic attributes in DDS ME composite.
- Inverse dependency of ME coupling factor on circumferential interface length.

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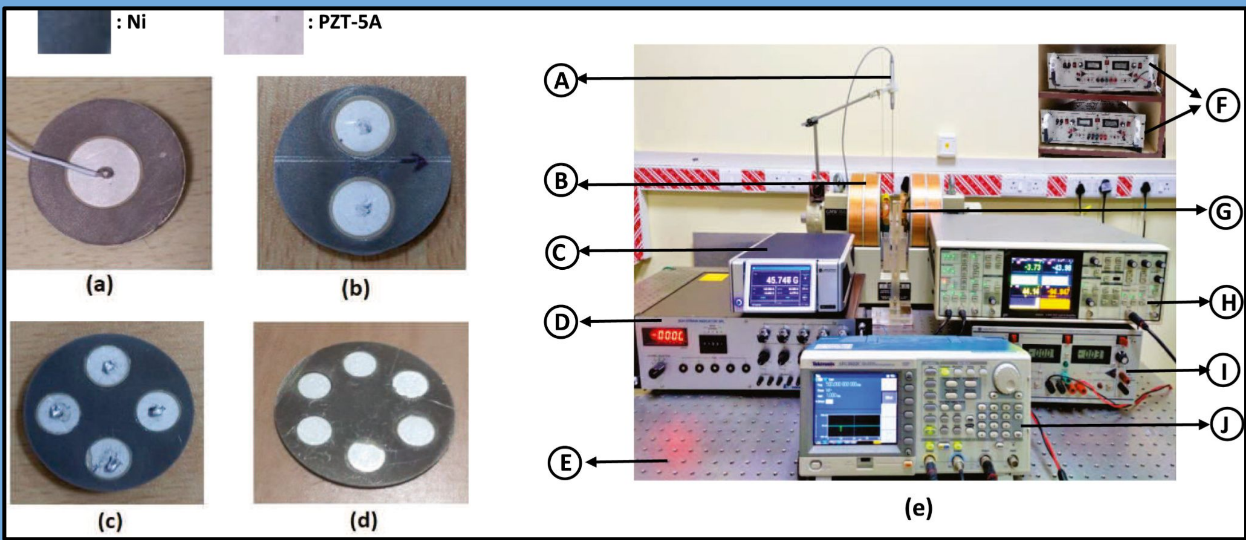

Fabricated configuration of ME composites (a) Disc/ring (b) DDS2 (c) DDS4 (d) DDS6; (e) Setup used for magnetostriction and ME measurement- A: Hall probe, B: Electromagnet, C: Gaussmeter, D: Strain indicator, E: Vibration isolation table, F: Power supplies, G: Helmholtz coil, H: Lock-in amplifier, I: AC amplifier; J: Function generator.

Acknowledgments

This work is financially assisted by the Science and Engineering Research Board (SERB), DST, India under project no. (EMR/ 2015/ 001559). The authors would like to extend their gratitude to the Defence Metallurgical Research Laboratory (DMRL) Hyderabad, India and Defence Research and Development Organisation (DRDO), India under ER&IPR scheme (Project No. ERIP/ ER/ 201612008/M/01/1713). The funding received from Institute of Eminence Research Initiative Project on Materials and manufacturing for Futuristic mobility, India (Project no. SB20210850MMMHRD008275) is gratefully acknowledged. The authors gratefully acknowledge Dr J Arout Chelvane, DMRL, India for the effective technical discussions.

Composite Structures

https://doi.org/10.1016/j.compstruct.2021.114958

SELECTED RESEARCH OUTCOMES

Evolution of nonlinear magneto-elastic constitutive laws in ferromagnetic materials: A comprehensive review

HIGHLIGHTS

- Anhysteretic and hysteretic nonlinear ferromagnetic constitutive modeling approaches from 1930s to 2020.
- Incorporation of effects of magnetic field, stress, temperature, and plastic deformation in constitutive laws.
- Future directions and further scope for accurately modeling the physics of ferromagnetic phenomena.

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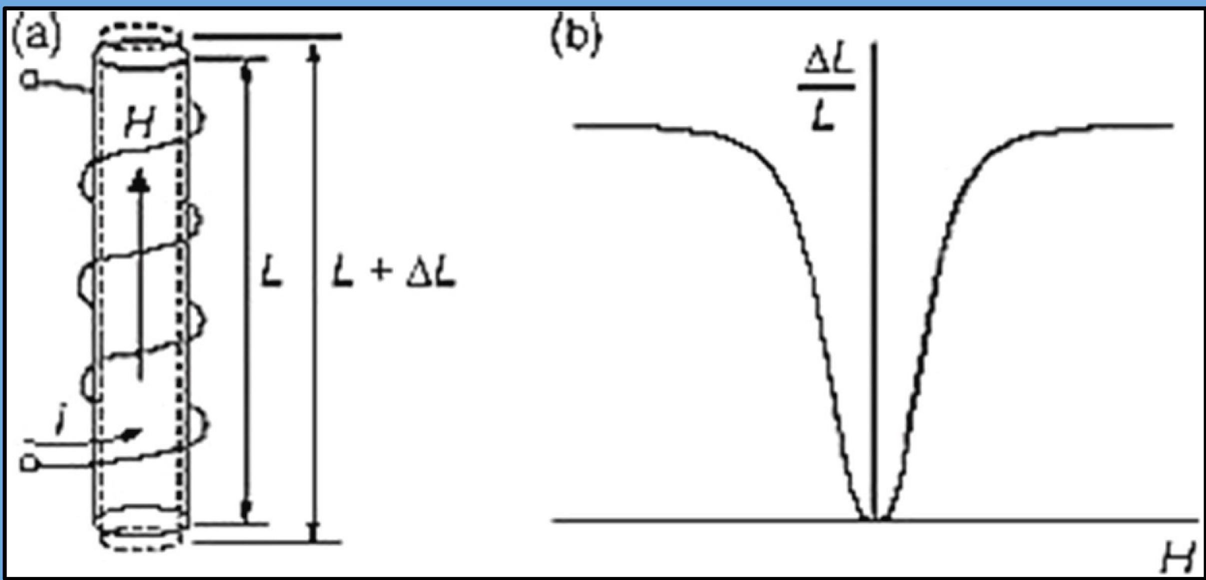

Schematic of the Joule magnetostriction observed in a magnetic rod (a) Change in shape with respect to applied magnetic field (b) Dependence of magnetostriction on

Acknowledgments

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Journal of Magnetism and Magnetic Materials
https://doi.org/10.1016/j.jmmm.2021.168821

SELECTED RESEARCH OUTCOMES

Enhanced self-biased magnetoelectric response in novel distributed disc structure Ni/PZT composite

HIGHLIGHTS

- Novel distributed disc structured (DDS) ME composites have been fabricated.
- Epoxy-free fabrication technique in form of press-fit method has been employed.
- Quasi-static ME, resonant ME and magnetostriction studies have been conducted.
- Inherent compressive prestress significantly increases the self-biased ME response.

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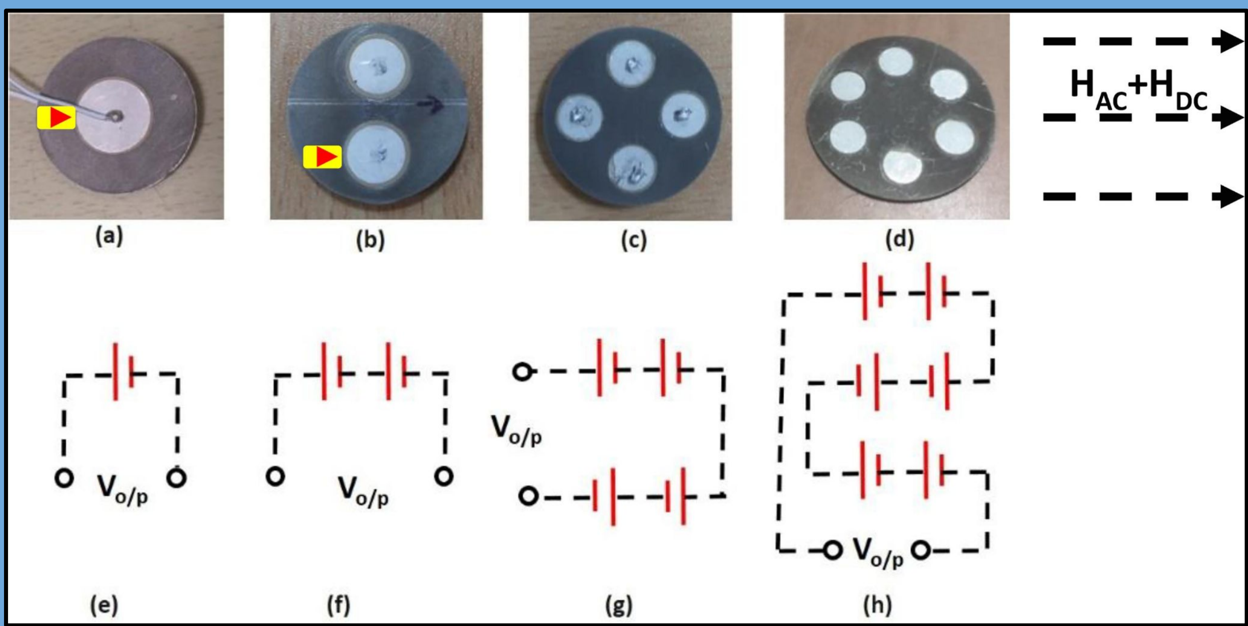

(a) Disc/Ring (b) DDS2 (c) DDS4 (d) DDS6 (e-h) Series connectivity of PZT discs in various configurations; (Note: grey-Nickel; white: PZT-5A; Yellow: Strain Gauge; Red Arrow: Direction of strain measurement).

Acknowledgement

This work is financially assisted by the Science and Engineering Research Board (SERB), DST, India under project no. EMR/2015/001559. The authors would like to extend their gratitude to the Defence Metallurgical Research Laboratory (DMRL) Hyderabad, India and Defence Research and Development Organization (DRDO), India under ER\&IPR scheme Project No. ERIP/ER/201612008/M/01/1713. The funding received from Institute of Eminence Research Initiative Project on Materials and manufacturing for Futuristic mobility (Project no. SB20210850MMMHRD008275) is gratefully acknowledged.

A.K., J.A.C., and A.A. are inventors on a pending patent-Application No.: 202141014859, describing Distributed disc structured magnetoelectric composite device.

Materials Letters

https://doi.org/10.1016/j.matlet.2021.130834

SELECTED RESEARCH OUTCOMES

Influence of water content on the mechanical behavior of gelatin based hydrogels: Synthesis, characterization and modeling

HIGHLIGHTS

- Effect of variation of water content on the mechanical properties of gelatin-based hydrogels is investigated.
- Pure gelatin hydrogels and gelatin/polyvinyl alcohol-based composite hydrogels having 90%, 70%, and 50% water content are prepared using the solvent casting method.
- Simulations based on the multistart optimization are performed to obtain the material parameters using the proposed model.

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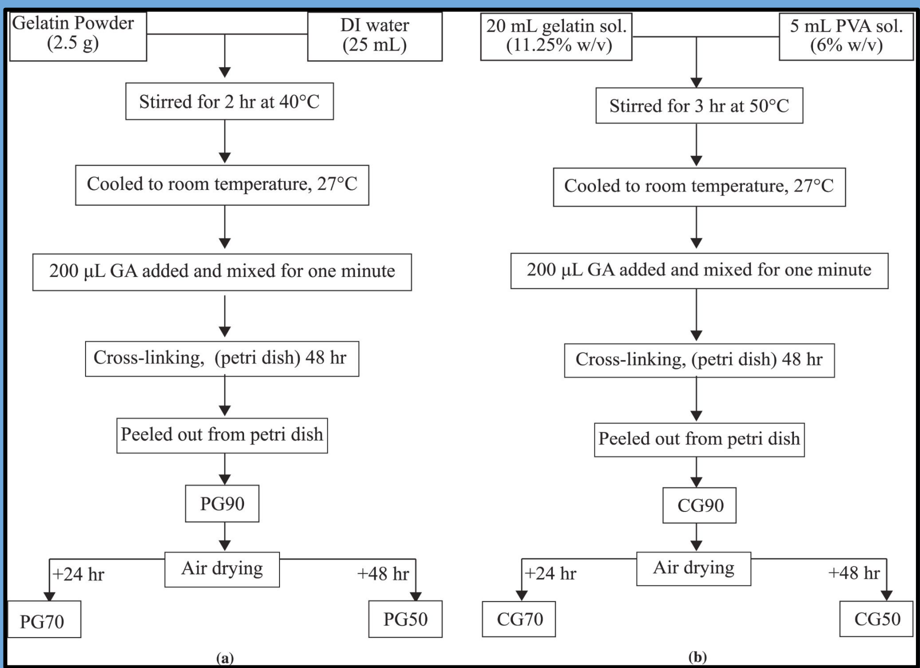
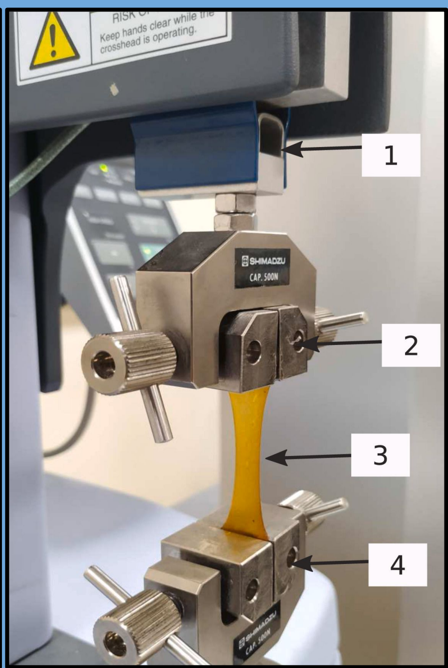


Schematic flowchart for the synthesis of (a) pure (PG90, PG70, PG50) and (b) composite (CG90, CG70, CG50) gelatin hydrogels having 90%, 70%, and 50% water content.



Experimental setup for the mechanical characterization using Universal Testing Machine, UTM

Acknowledgments

A. Arockiarajan would like to acknowledge the Indian Institute of Technology Madras (IIT Madras) for providing the financial aid under Project No. SB20210850MMMHRD008275 through the Institute of Eminence. Ganesh Tamadapu would like to acknowledge the Department of Science and Technology (DST), Government of India , for providing the financial aid under the project number DST/INSPIRE/04/2015/ 002112.

International Journal of Solids and Structures

https://doi.org/10.1016/j.ijsolstr.2021.111219

SELECTED RESEARCH OUTCOMES

Bending of hard-magnetic soft beams: A finite elasticity approach with anticlastic bending

HIGHLIGHTS

- An analytical solution for the bending of hard-magnetic soft beam has been derived.
- Mooney–Rivlin model has been used to capture the non-linearity of the material.
- Coupled anticlastic bending has also been incorporated into the framework.
- Prony series approximation was used to encapsulate the time-dependent response.

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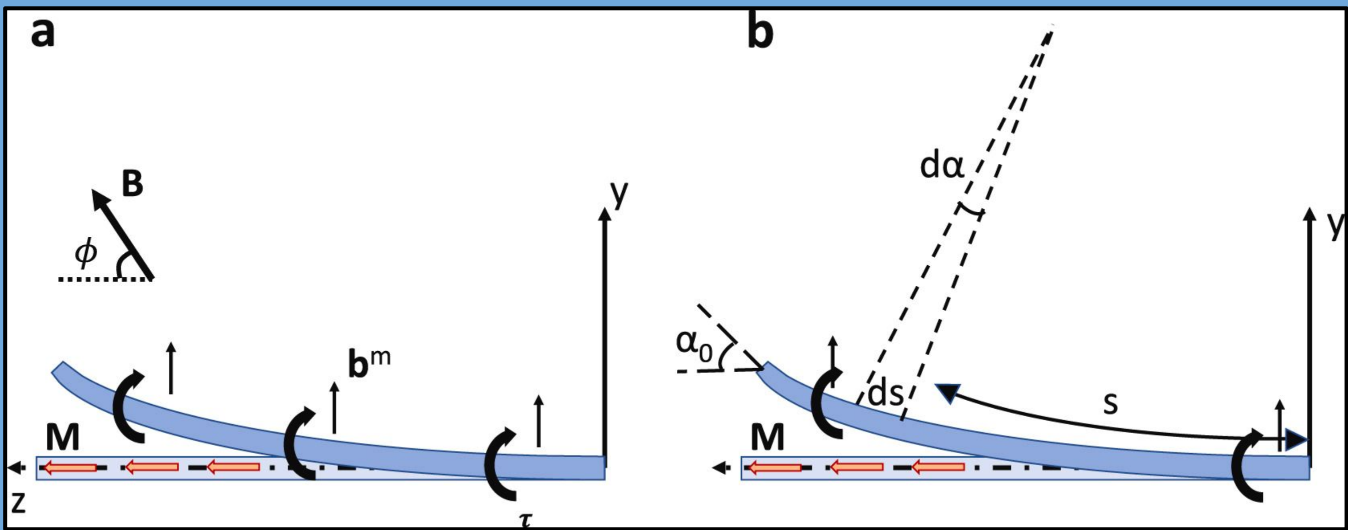

(a) Reference and deformed configuration of a hard-magnetic soft beam under the influence of an applied magnetic field . is the magnetization vector in the reference state. and are the externally applied magnetic field and the angle between the field and . is the magnetic body force (as shown in Eq. (9)) and is torque (given in (12)). (b) The deformed configuration of the beam under the applied magnetic field. is the free-end angular displacement. The angle of bending as a function of the beam length is represented by

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European Journal of Mechanics - A/Solids

https://doi.org/10.1016/j.euromechsol.2021.104374

SELECTED RESEARCH OUTCOMES

Structural, magnetic and magnetoelectric investigations on CoFe2O4 prepared via various wet chemical synthesis route : A Comparative Study

HIGHLIGHTS

- CFO prepared by autocombustion, Co-precipitation, Sol-gel and hydrothermal route.
- Structural, magnetic, magnetostrictive, and magnetoelectric characterisation.
- Static, dynamic and prestress effects on the CFO/PZT/CFO composite has been studied.

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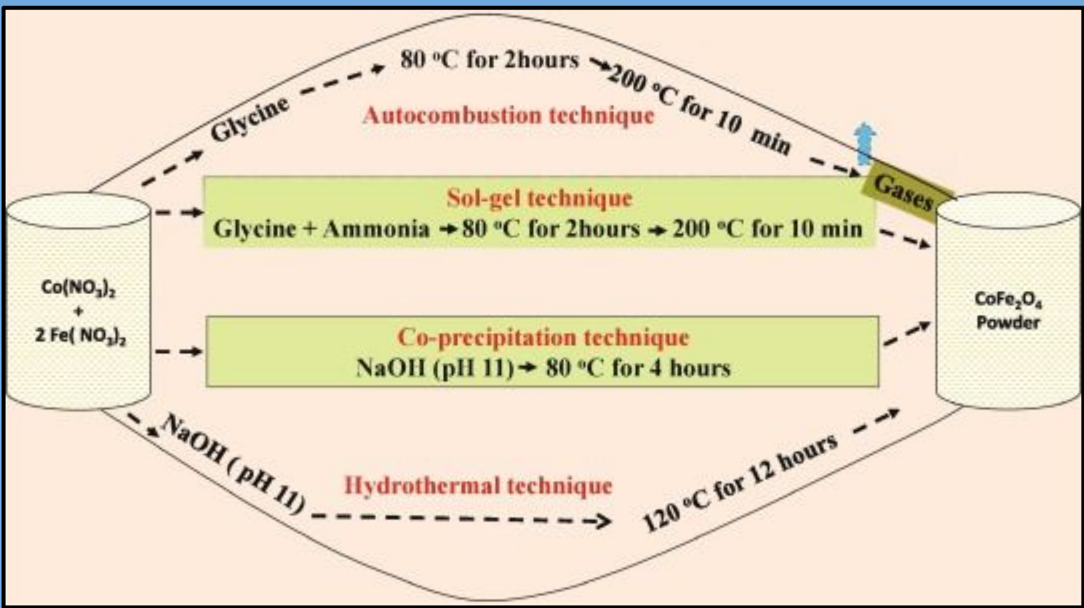

Flowchart of four wet chemical synthesis route

Acknowledgement

K.V Siva would like to thank Indian Institute of Technology, Madras for providing the post-doctoral fellowship to conduct this research. The authors would also like to acknowledge the Science and Engineering Research Board (SERB), DST, India for providing the financial aid under Project No. EMR/2015/001559 and Indian Institute of Technology Madras (IIT Madras) under Project No. SB20210850MMMHRD008275) through Institute of Eminence. The authors would also like to thank Dr. Arout Chelvane, DMRL, DRDO Hyderabad for providing the VSM facility and his insightful comments for the betterment of this work. Additionally, the authors would also like to extend their gratitude towards ICSR, IIT Madras for helping us to take the SEM data.

Journal of Magnetism and Magnetic Materials

https://doi.org/10.1016/j.jmmm.2021.168065

SELECTED RESEARCH OUTCOMES

Thin film metallic glasses for bioimplants and surgical tools: A review

HIGHLIGHTS

- The present work reviewed the recent developments and advances of biomedical TFMG systems.
- The TFMGs have gained attention as they exhibit an excellent properties for versatile biomedical implant applications.
- The corrosion behavior of TFMGs is of great importance to understand their chemical and environmental stability.
- The TFMG coated blades improves sharpness.
- Degradable metallic glasses (bulk and thin films) are sparingly reported and opens a new area to be explored further.

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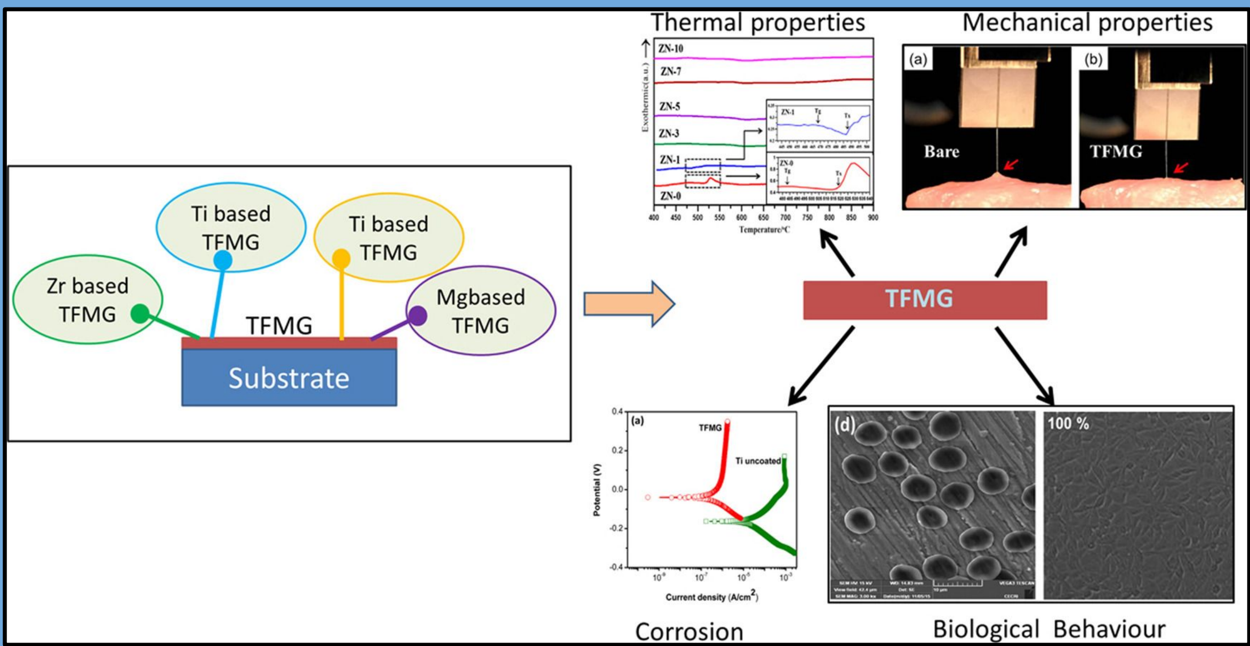

Graphical Abstract

Acknowledgements

The authors hereby acknowledge the funding obtained Indian Institute of Technology Madras, India (IIT Madras) (SB20210850MMMHRD008275) through Institute of Eminence. One of the authors S Thanka Rajan thank the IIT Madras, Chennai for providing him the post-doctoral fellowship (IPDF) and the research grant for this research.

Journal of Alloys and Compounds

https://doi.org/10.1016/j.jmmm.2021.168065

SELECTED RESEARCH OUTCOMES

Photoresponse of a printed transparent silver nanowire-zinc oxide nanocomposite

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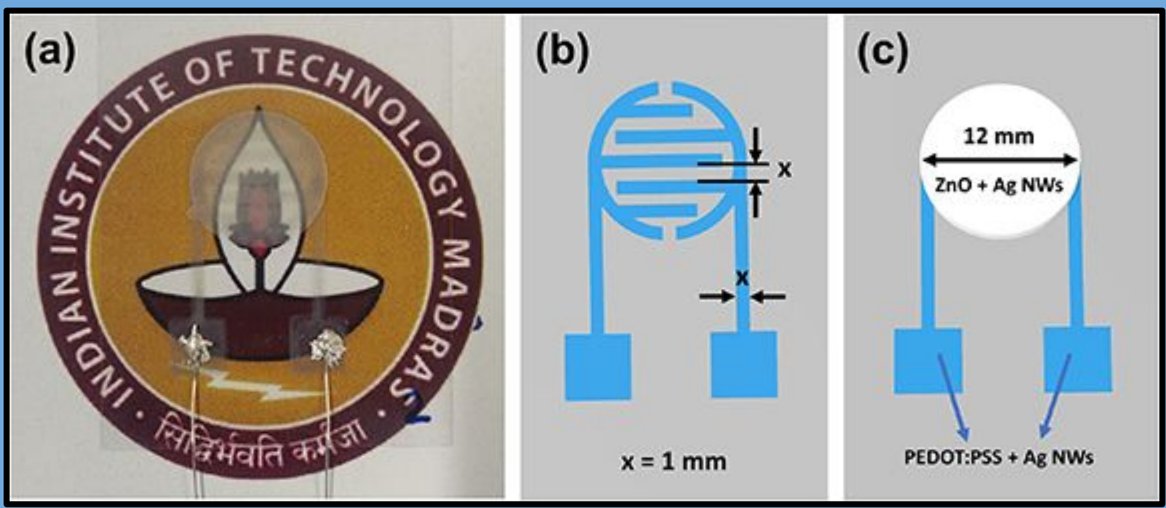
HIGHLIGHTS

- Demonstrate a printed transparent PD with an absorber layer based on a nanocomposite of ZnO with silver nanowires (Ag NWs).
- The PD exhibits an improved photoresponsivity of 35 mA W^{-1}, at a relatively low biasing voltage of 1 V, compared to a pure ZnO absorber layer with a responsivity of 14 mA W^{-1} at 5 V bias for an illumination at 365 nm.
- The properties of the nanocomposite make it suitable for single layer, low cost, and large area transparent PDs.



The structure of the fabricated PD. (a) The PD is placed over the logo of IIT Madras to demonstrate its transparency. (b) The dimensions of the printed electrodes and (c) the dimensions of the absorber layer and the materials used for the absorber and the electrodes.s

Acknowledgments

The work was supported by IIT Madras under the Institute of Eminence Research Initiative Project on Materials and Manufacturing for Futuristic Mobility (Project No. SB20210850MMMHRD008275). The authors would like to acknowledge the Department of Chemical Engineering, IIT Madras for the SEM measurements. The viscosity measurements were done in the Polymer Engineering and Colloidal Science (PECS) Laboratory, Department of Chemical Engineering, IIT Madras. The solar simulator measurements were carried out at the Soft Matter and Complex Fluids Laboratory, Department of Metallurgical and Materials Engineering, IIT Madras.

Flexible and Printed Electronics
https://doi.org/10.1088/2058-8585/ac2e48

SELECTED RESEARCH OUTCOMES

Estimation of Local Strain Fields in Two-Phase Elastic Composite Materials Using UNet-Based Deep Learning

HIGHLIGHTS

- We use one of the deep learning-based algorithms known as the UNet to predict the local strain fields in a two-phase composite material subjected to uniaxial tensile load.
- The model is trained and tested on 1200 two-phase microstructures comprising two-volume fraction categories and six different morphological classes. An R2 score of 94% is achieved on the test dataset.
- A detailed statistical analysis is performed to understand the role of the volume fraction and the ratio of elastic moduli of the phases in the deep learning model's trainability.

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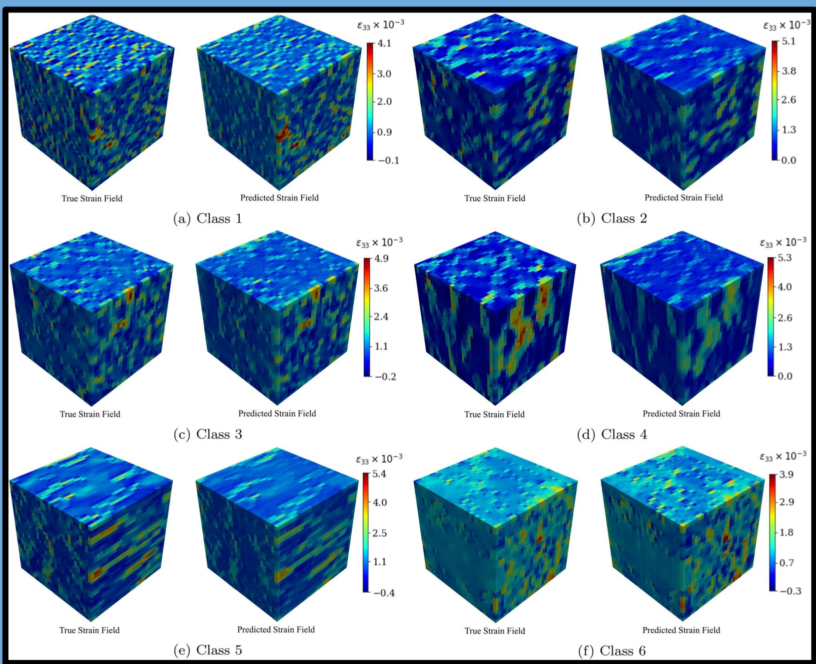

Comparison of the true strain field (from FEM) and predicted strain field (from UNet) on an arbitrary chosen RVE from each class (volume fraction 30%)

Acknowledgments

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Integrating Materials and Manufacturing Innovation
https://doi.org/10.1007/s40192-021-00227-2

SELECTED RESEARCH OUTCOMES

COMBUSTION SYNTHESIS OF LUMINESCENT Eu-DOPED SINGLE PHASE MAYENITE

HIGHLIGHTS

- Single phase Eu-doped mayenite powders synthesised using low cost, energy efficient combustion synthesis
- Structural analysis of doped samples shows substitution of Ca^{2+} ions by Eu^{3+} ions on doping
- Photoluminescence emission spectra revealed $5d^0 \rightarrow 7f^2$ transition and was characterized by the bright red luminescence
- The doping of Eu resulted in a decrease of band gap from 4.8 eV for undoped mayenite to 3.5 eV for 1.5% Eu doped mayenite
- Eu-doped mayenite exhibited excellent fluorescent properties under UV irradiation

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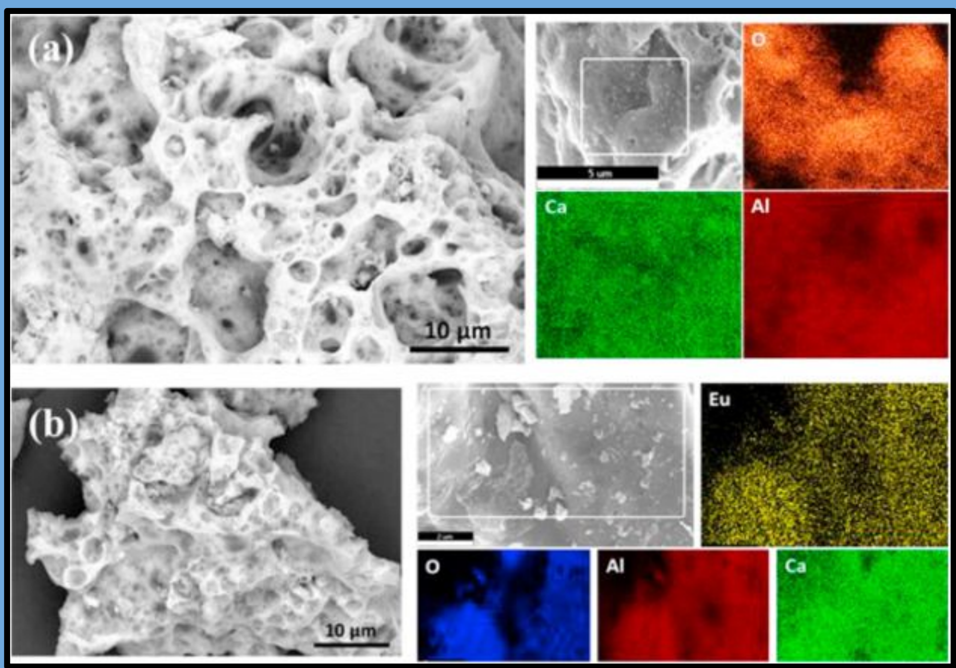

Scanning electron microstructures of the obtained porous Mayenite structures

Combustion synthesis of luminescent Eu-doped single phase Mayenite

T. Kumaresh [a, b], Eranezhuth Wasan Awin [a, b], Lalith Kumar Bhaskar [a, b], Marija Prekajski Djordjevic [c], Branko Matović [c], Ravi Kumar [a, b]

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Journal of Solid State Chemistry

https://doi.org/10.1016/j.jssc.2021.122420

SELECTED RESEARCH OUTCOMES

$TiNb_2O_7$-Keratin derived carbon nanocomposites as novel anode materials for high-capacity lithium-ion batteries

HIGHLIGHTS

- Porous and conductive TNBO/KC nanocomposites anode material for LIBs were synthesized from surfactant assisted precursor route followed by heat-treatment under N_2 atmosphere.
- Compared to pristine TNBO800, TNBO/KC yielded reduced crystalline $(Ti_{0.712}Nb_{0.288})O_2$ phase and $TiNb_2O_7$ phase with higher specific surface area (28 $m^2\ g^{-1}$ vs. 89 $m^2\ g^{-1}$)
- The experimental data attests the potential of $TiNb_2O_7$/keratin derived carbon nanocomposites as economically and environmentally viable promising anode material for LIBs.

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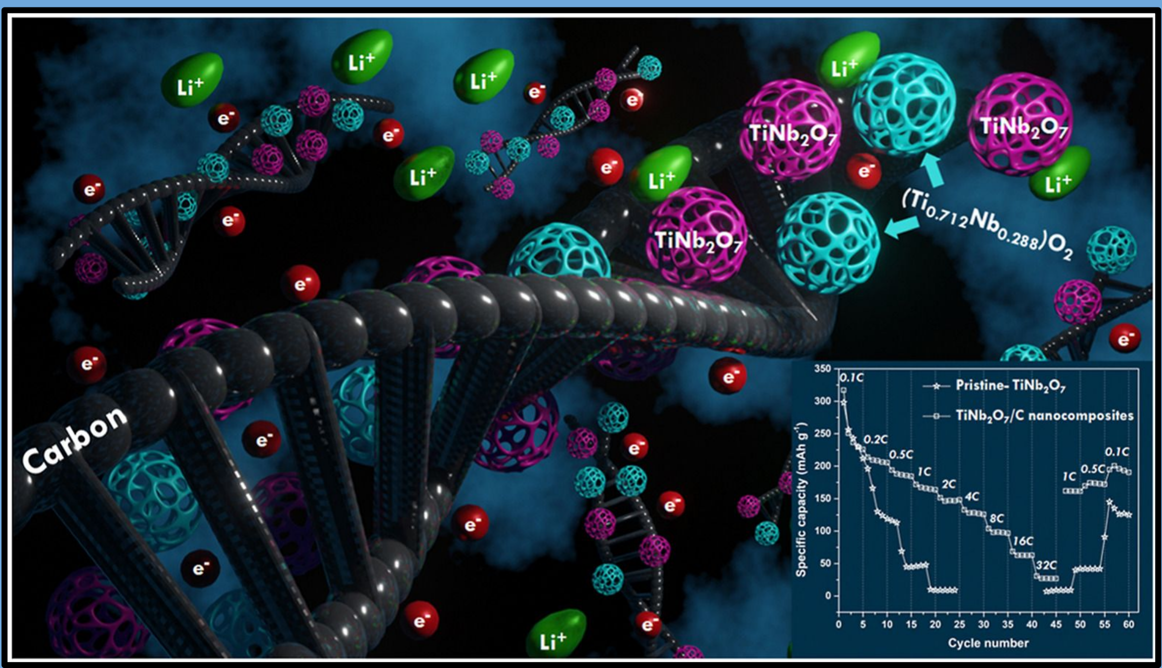

Graphical Abstract

Acknowledgements

The authors would like to thank Noel A for assisting in preparation of KC. The authors would also gratefully acknowledge sophisticated analytical instrument facility (SAIF), IIT Madras for the analytical support. One of the authors (Ganesh Babu T) thanks IIT Madras for institute postdoctoral fellowship (IPDF). The authors gratefully acknowledge financial assistance received through the Scheme for Promotion of Academic and Research Collaboration (SPARC), Department of Science and Technology (DST), Government of India (Project No.: SPARC/2018–2019/P781/SL; IITM Ref. No.: MET1819199SPARRAVK). The authors would also like to thank infrastructural support provided by University of Cologne, Germany. The funding received from the Institute of Eminence Research Initiative Project on Materials and Manufacturing for Futuristic Mobility (project no. SB20210850MMMHRD008275) is gratefully acknowledged.

Open Ceramics
https://doi.org/10.1016/j.oceram.2021.100131

SELECTED RESEARCH OUTCOMES

Microstructural transitions in camphene-based freeze casted ceria: effect of primary building blocks

HIGHLIGHTS

- We demonstrate porous ceria with an open porosity of 88% developed through camphene assisted freeze casting for the first time.
- Microstructural evolution with different building blocks – micrometre-sized particles and short fibres were also studied.
- Preliminary catalytic activity obtained via temperature programmed reduction exemplified similar profiles showing no effect of the initial building blocks on the activity.

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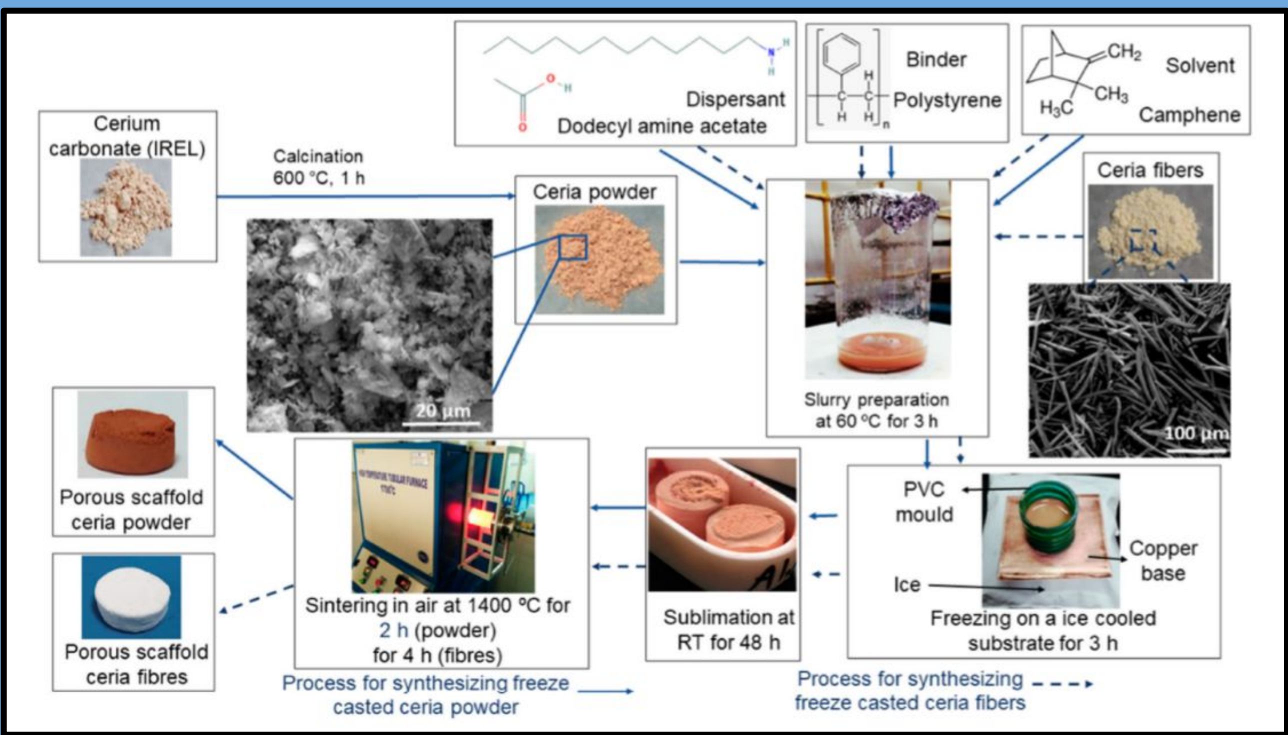

. Development of freeze casted scaffolds: process overview.

Acknowledgements

The authors would like to thank Ritam Ghosh for his assistance in preparation of scaffolds.The authors would also like to gratefully acknowledge the funding received for the purchase of chemicals(Grant number CHY/16-17/348/MUAY/GRAN). The authors thank the Department of Chemistry, IIT Madras for providing access to TPR facility.The funding received from the Institute of Eminence Research Initiative Project on Materials and Manfacturing for Futuristic Mobility (Project No:SB20210850MMMHRD008275) is gratefully acknowledged.

Advances in Applied Ceramics, Structural, Functional and Bioceramics
https://doi.org/10.1080/17436753.2021.1945850

SELECTED RESEARCH OUTCOMES

Microstructural transitions in camphene-based freeze casted ceria: effect of primary building blocks

HIGHLIGHTS

- Ablation behaviour of poly(hydridomethylsiloxane) derived open and closed porous structured SiOC ceramic foams was evaluated using oxy-acetylene flame at 1500°C for various time durations
- X-ray diffraction and scanning electron microscopy analyses of ablated SiOC ceramic foams revealed the formation of a thin protective SiO_2 layer inhibiting further oxidation.
- The closed porous structured SiOC ceramic foams exhibited very low mass ablation rate in contrast to open porous structured SiOC ceramic foams owing to the differences in thermal energy dissipation mechanism.
- The feasibility of the plausible foam reduction reactions pertaining to the ablation mechanism was further investigated by computing the Gibbs energy and HR-TEM analysis

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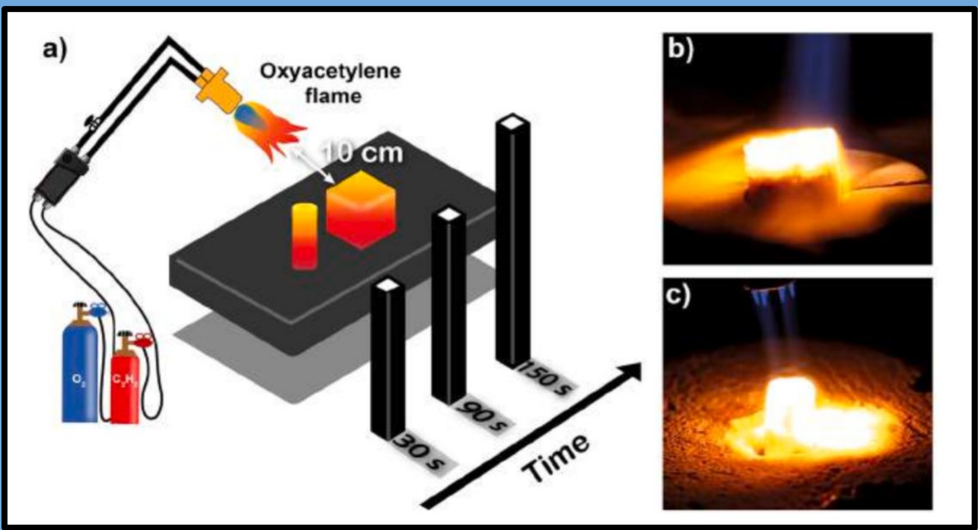


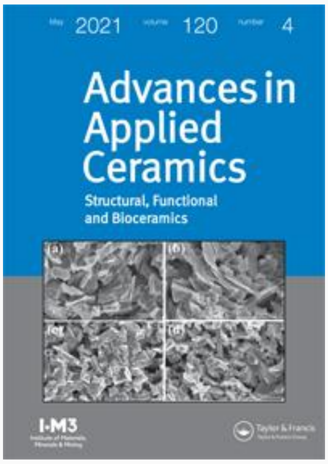
. a) Schematic representation of the ablation resistance testing. Real-time photographical image of b) SiOC-OpenPF and c) SiOC-ClosedPF during ablation testing.

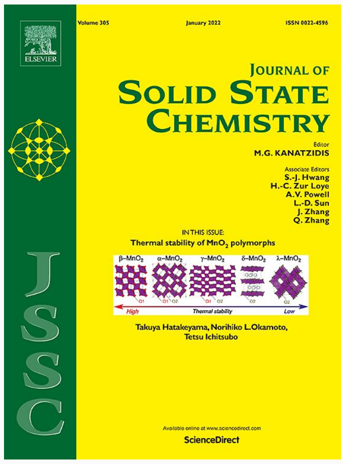
Acknowledgements

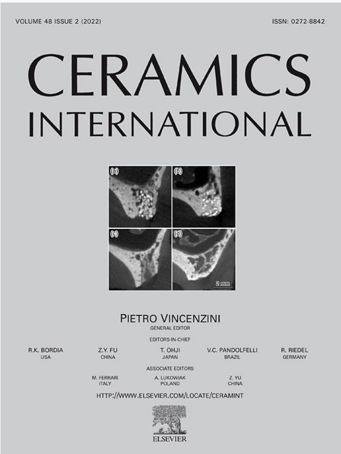
The authors thank sophisticated analytical instrument facility (SAIF), IIT Madras for the analytical support. One of the authors (Ganesh Babu Thiyagarajan) thanks IIT Madras for Institute Post-Doctoral Fellowship (IPDF). The funding received from the Institute of Eminence Research Initiative Project on Materials and Manufacturing for Futuristic Mobility (project no. SB20210850MMMHRD008275) is gratefully acknowledged.

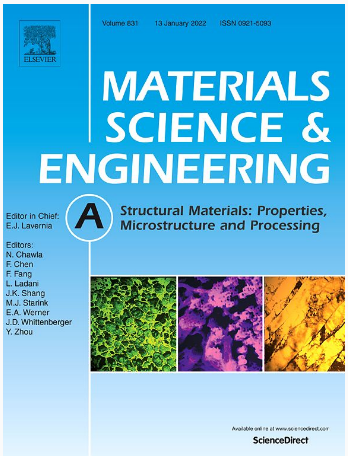
Journal of the European Ceramic Society
https://doi.org/10.1016/j.jeurceramsoc.2021.11.033

LIST OF PUBLICATIONS









1. Numerical interpretation and experimental investigation of enhanced magnetoelectric effect in Ni/PZT distributed disc structured composite
   Amritesh Kumar and A. Arockiarajan
   Composite Structures, 280. 2022, 114958.

2. Evolution of nonlinear magneto-elastic constitutive laws in ferromagnetic materials: A comprehensive review
   Amritesh Kumar and A. Arockiarajan
   Journal of Magnetism and Magnetic Materials, 546, 2022, 168221

3. Electrical creep and fatigue in 0.5Ba($Zr_{0.2}Ti_{0.8}$)O_3-0.5(Ba0.7$Ca_{0.3}$)TiO_3 ceramics
   M. Sharma, S. Patel D. Kumar, A. Arockiarajan and Rahul Vaish
   Functional Material Letters, 2021, 14, 2150033

4. Novel class of precursor-derived Zr–La–B–C(O) based ceramics containing nano-crystalline ultra-high temperature phases stable beyond 1600 °C
   Gokul Nanda, Ganesh Babu Thiyagarajan, KC Hari Kumar, Renjith Devasia, and RaviKumar
   Ceramics International Volume 48, Issue 2, 15 January 2022,

LIST OF PUBLICATIONS

5. Enhanced self-biased magnetoelectric response in novel distributed disc structure Ni/PZT composite
Amritesh Kumar, Arout Chelvane and A. Arockiarajan
Materials letters, 305, 2021, 130834

6. Influence of water content on the mechanical behavior of gelatin based hydrogels: Synthesis, characterization and modeling.
Vivek Manish, A. Arockiarajan and Ganesh Tamadapu
International Journal of Solids and Structures, 233, 2021, 111219.

7. Bending of hard-magnetic soft beams: A finite elasticity approach with anticlastic bending.
Aakila Rajan and A. Arockiarajan
European Journal of Mechanics / A Solids, 90, 2021, 104374.

8. Structural, magnetic and magnetoelectric investigations on $CoFe_2O_4$ prepared via various wet chemical synthesis route : A Comparative Study
K. Venkata Siva, Amritesh Kumar, and A. Arockiarajan
Journal of Magnetism and Magnetic Materials, 535, 2021, 168065

9. Combustion synthesis of luminescent Eu-doped single phase Mayenite
T Kumaresh, Eranezhuth Wasan Awin, Lalith Kumar Bhaskar, Marija Prekajski Djordjevic, Branko Matović, Ravi Kumar
Journal of Solid State Chemistry, Volume 302, October 2021, 122420

10. Photoresponse of a printed transparent silver nanowire-zinc oxide nanocomposite
Nitheesh M Nair, Mohammad Mahaboob Jahanara, Debdutta Ray and P Swaminathan
Flexible and Printed Electronics, Volume 6, Number 4, 2021

11. Estimation of Local Strain Fields in Two-Phase Elastic Composite Materials Using UNet-Based Deep Learning
Mayank Raj, Sanket Thakre, Ratna Kumar Annabattula & Anand K Kanjarla
Integrating Materials and Manufacturing Innovation, 10, pages444–460 (2021)

12. Thin film metallic glasses for bioimplants and surgical tools: A review
S. Thanka Rajan, A. Arockiarajan
Journal of Alloys and Compounds, Volume 876, 25 September 2021, 159939

LIST OF PUBLICATIONS

13. $TiNb_2O_7$-Keratin derived carbon nanocomposites as novel anode materials for high-capacity lithium-ion batteries
Ganesh Babu Thiyagarajan, Vasu Shanmugam, Michael Wilhelm, Sanjay Mathur, Sahana B. Moodakare, Ravi Kumar
Open Ceramics, Volume 6, June 2021, 100131

14. Microstructural transitions in camphene-based freeze casted ceria: effect of primary building blocks
Raghunath Sharma Mukkavilli, Kousik Papakollu & Ravi Kumar
Advances in Applied Ceramics, Structural, Functional and Bioceramics, Volume 120, 2021

15. Microstructure dependent ablation behaviour of precursor derived SiOC ceramic foam for high temperature applications
Pradhyun Veerapanaicker Soundaraj, Santhosh Sivan Sembulingam, Ganesh Babu Thiyagarajan, Niraja Moharana, K.C. Hari Kumar, Ravi Kumar
Journal of the European Ceramic Society, Volume 42, Issue 3, March 2022, Pages 877-889

16. Multifunctional, environmental coatings on AA2024 by combining anodization with sol-gel process
M. Arunoday, K. Pradeep Premkumar, Ravi Kumar, and R. Subasri
Ceramics International, Online January 2022 (in Press)

17. Annealing induced changes in optoelectronic properties of sputtered copper oxide films
Aarju Mathew Koshy, A. Sudha, Prince Gollapalli, Satyesh Kumar Yadav, P. Swaminathan
Journal of Materials Science: Materials in Electronics (under Review)

18. A review of silver nanowire-based composites for flexible electronic applications
Neha Sharma. Nitheesh M. Nair, Garikapati Nagasarvari, Debdutta Ray, Parasuraman Swaminathan
Flexible and Printed Electronics (under review)

19. Template-assisted synthesis coupled with strong alkali etching to develop Zn/ZnO superstructures for CO_2 reduction
Manasa Adavalli, Rajendran Rajaraman, Lakshman Neelakantan, Parasuraman Swaminathan
RSC Advances - joint work with Dr. Lakshman Neelakantan (under review)

20. Enhancement of the rectification behavior of zinc oxide based Schottky diodes by nickel oxide addition
Mahaboob Jahanara Mohammad, Hari Ramachandran, Parasuraman Swaminathan
Journal of Electronic Materials (under review)

RECOGNITIONS

Member of the Expert Review Committee for CoE

Ravi Kumar N V as member of the Expert Review Committee for the project on "Establishment of Centre of Excellence (CoE) on Intelligent Internet of Things (IIoT) Sensors at Makers Village, Kochi" for implementation by Centre for Materials for Electronics Technology (C-MET),

Dr. rer. nat. Ravi Kumar
Laboratory for High Performance Ceramics, IITM

Guest Editor in Open Ceramics

Dr. rer. nat. Ravi Kumar N V has been invited to edit one special edition of the "Open Ceramics." The journal Open Ceramics solicits original high-quality articles for the "Special Issue on Electrospun Fibers"

Editorial Board of Scientific Reports

Dr. rer. nat. Ravi Kumar N V has been invited to serve as an Editorial Board Member for the Materials Chemistry Section of 'Scientific Reports', a Nature Research publication.

RECOGNITIONS

Prof. Dr. Dr. (h.c.) Sanjay Mathur
Director, Institute of Inorganic Chemistry
University of Cologne, Germany

MRS Woody White Service Award

MRS Woody White Service Award 2021- The award honors outstanding individuals who have embodied MRS's mission, vision, and values for an egalitarian interdisciplinary community advancing materials science and technologies.

Foreign Fellow of the NASI

Foreign Fellow of the National Academy of Science (NASI) 2021. NASI is one of the oldest Science Academy of India established in the year 1930 by a group of world-famous scientists led by Prof. Meghnad Saha (the Founder President).

RECOGNITIONS

Hari Kumar K.C
Laboratory for CALPHAD, IITM

Associate Editor of JPED

The Journal of Phase Equilibria and Diffusion (JPED) focuses on the crystallographic, chemical, diffusion, and other kinetic properties of phases.

Editor of MSIT

Materials Science International Team (MSIT) is a network of materials scientists and laboratories competent in materials' constitution and experimental & computational thermodynamics of materials.

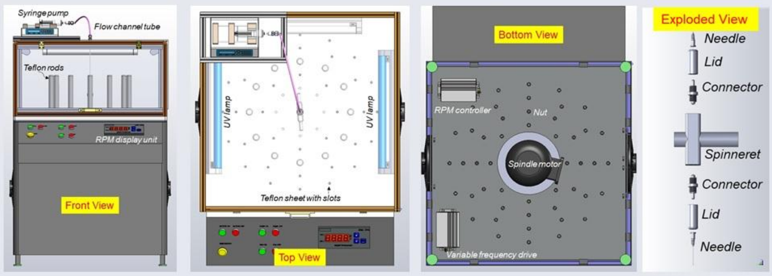
INDIAN PATENT FILED

UV-LIGHT INTEGRATED ULTRA-SPINNING DEVICE FOR HIGH THROUGHPUT PRODUCTION OF NON-WOVEN POLYMER AND CERAMIC NANOFIBERS/MICROFIBERS

Inventor:	Dr. Ganesh Babu Raghunath Sharma MVSS Dr. rer. nat. Ravi Kumar
Patent application no.	202141048319
Filing Date	October 22, 2021

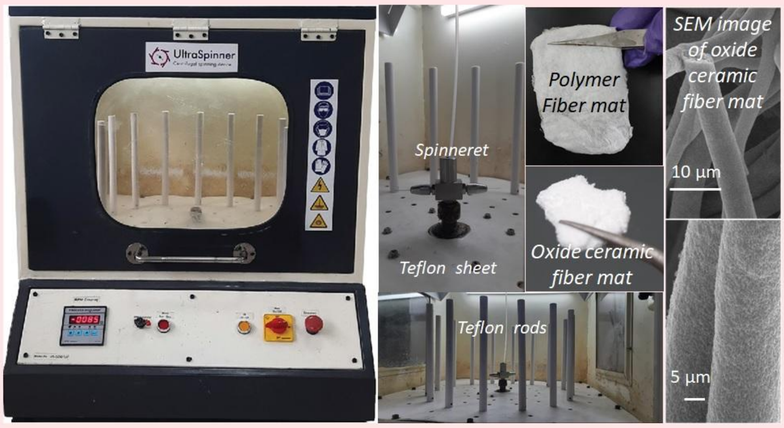
Dr. rer. nat. Ravi Kumar
Laboratory for High Performance Ceramics, IITM

Ultraspinner- Design salient features



- Controlled solution discharge rate to the nozzle
- Variable distance of spinneret orifice to collector [50-200 mm]
- Tunable UV light (highly novel)
- Variable rotational speed [0-24000 rpm]
- User-friendly & easily assembled setup

Ultraspinner- In-house developed prototype



Highlights:

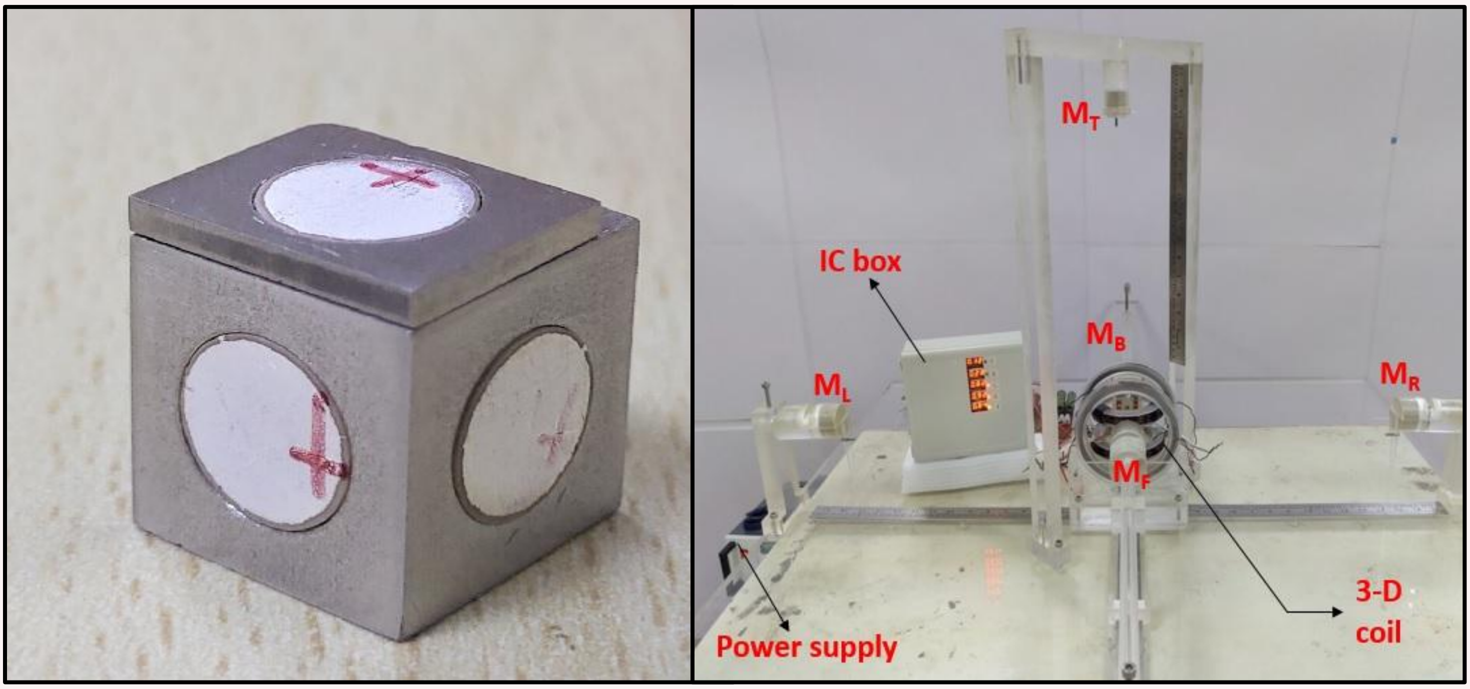
- No usage of high voltages to produce fibers
- Variable collector distance; Fibres can be collected at various distances (5-20 cm) from the spinneret with simultaneous application of UV radiation.
- High rotation speed up to 24,000 rpm are possible
- Flexible UV light intensity up to 325 W to enhance cross linking of the polymer/preceramic fibre mat.

INDIAN PATENT FILED

MAGNETO-ELECTRIC BASED MAGNETIC SENSOR AND METHOD THEREOF

Inventor:	Amritesh Kumar S. Veeraraghavan M. Dileesh A. Arockiarajan
Patent application no.	202141055994
Filing Date	December 2, 2021

Prof. A. Arockiarajan
Head
Smart Material Characterization Lab
IIT Madras



Highlights:

- The invention can be used as sensors in the form of magnetometers as well as miniature current sensors.
- Since the proposed novel DDS configurations show a significant ME response at a very low field, they can be used to detect weak magnetic fields, of which one of the most potent application is in detectors.
- Can replace the conventional layered ME composites in Pressure based sensors owing to their high sensitivity.

INDIAN PATENT FILED

AAO TEMPLATE-ASSISTED SYNTHESIS PROCESS COUPLED WITH ALKALI ETCHING TO DEVELOP ZINC OXIDE BRANCHED SUPERSTRUCTURES

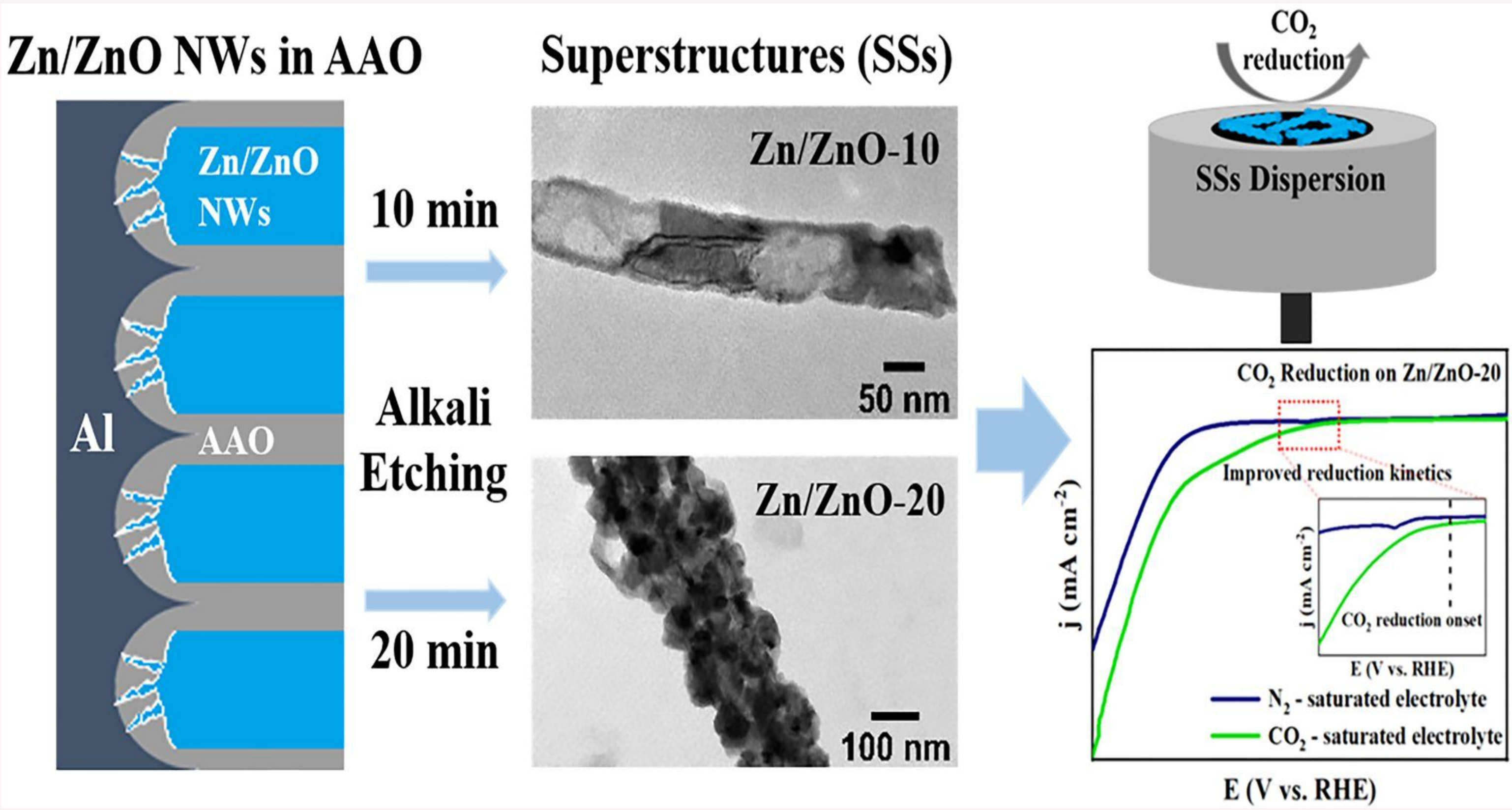
Inventor: Manasa Hari Adavalli
Lakshman Neelakantan
P. Swaminathan

Patent application no. 202141048319

Filing Date December 13, 2021

Prof. Lakshman Neelakantan
Head
Corrosion Engineering and Materials Electrochemistry Lab
IIT Madras

Prof. Parasuraman Swaminathan
Head
Electronic Materials and Thin Films Lab
IIT Madras



Highlights:

- Anodic aluminium oxide template-assisted synthesis of 1D zinc oxide nanostructures
- Control of morphology by etching to form 3D superstructure with enhanced surface area
- Room temperature CO_2 reduction
- Can be extended to other amphoteric single and mixed oxides

TECHNICAL TALKS & CONFERENCES

Webinar: Advanced Ceramics for Mobility

Centre of Excellence on Materials and Manufacturing for Futuristic Mobility has been formed as part of IIT Madras' Institute of Eminence initiative, with Ceramic Technologies for Futuristic Mobility being one of the center verticals. **Prof. Dr. Alexander Michaelis, Managing Director, Fraunhofer IKTS Institute for Ceramic Technologies and Systems IKTS, Germany**, delivered the first lecture in the series on **September 3, 2021**, at 2.00 PM (CET)/5.30 PM (IST).

IRIS Webinar: Advanced Manufacturing

On October 25, 2021, at 5 p.m., the Office of Global Engagement, Indian Institute of Technology, Madras, hosted an IRIS webinar. Prof. Ravi Kumar N V of IIT Madras & Prof. Sanjay Mathur of the University of Cologne, Germany, spoke on Materials and Manufacturing for Future Mobility.

TECHNICAL TALKS & CONFERENCES

Webinar: Next Generation Material Scientists

In this webinar series,A*star's Institute of Material Research and Engineering invites Materials scientists from around the world to share with you their cutting edge technologies that change our materials of tomorrow.

International conference on sensing technology

Pamula Sreekeerthi, Nitheesh M. Nair, Garikapati Nagasarvari, and Parasuraman Swaminathan, "Planar Capacitive Touch Sensors – A Comparative Study", 14th International Conference on Sensing Technology, IIT Madras, Jan 2022, accepted

VISITORS

Visit to Purdue University

Nithin Chandran BS
Doctoral Student

Nithin Chandran B S has been selected by India's Science and Engineering Research Board (SERB) Overseas Visiting Doctoral Fellowship Program (OVDF). He will spend one year from Jan 2022 in the Layered Materials and Structures Lab (LMSL) of Dr. Babak Anasori at Purdue University.

Visit to Kansas State University

S S Lokesh Vendra has visited the Kansas State University, Manhattan, KS, US as a part of his doctoral thesis for a period of three months (14 Sep- 14 Dec 2021). He worked under the co-supervision of Professor Gurpreet Singh for his doctoral thesis involves research activities in Kansas State University.

SS Lokesh Vendra
Doctoral Student

International Visitor to Centre

Dr. Mina Zare
Center for Nanotechnology & Sustainability,
National University of Singapore

Dr. Mina Zare was hosted by **CoE-Ceramic Technologies For Futuristic Mobility, IIT Madras.** She interacted with faculty members and students of Department of Metallurgical & Materials Engineering.

VISITORS

Visitor to Centre

Dr. Pushkar Mishra
Postdoctoral Researcher,
MATES lab, HRI

Dr. Pushkar Misra was hosted by CoE-Ceramic Technologies For Futuristic Mobility, IIT Madras. He interacted with faculty members and students of Department of Metallurgical & Materials Engineering in month of October 2021. His research work focus on chalcogenides doped with non-metal atoms (Carbon, Nitrogen and Phosphorus). He is working with Dr. Sudip Chakraborty at Harish Chandra Research Institute, Allahabad.

Visitor to Centre

Dr. Neelesh Gupta was hosted by CoE-Ceramic Technologies For Futuristic Mobility, IIT Madras. He interacted with faculty members and students of Department of Metallurgical & Materials Engineering in month of December 2021. He is working with Dr. Alankar Alankar at Indian Institute of Technology Bombay on Machine Learning based discovery of novel perovoskites for energy storage.

Dr. Neelesh Gupta
Postdoctoral
Researcher, ICME and
Materials Genome Lab, IIT
Bombay

WORKSHOPS

Pamula Sreekeerthi, Nitheesh M. Nair, Garikapati Nagasarvari, P. Swaminathan, "Combined experimental and computational study of printed capacitive touch sensors", **XXI International Workshop on Physics of Semiconductor Devices (IWPSD 2021)**, IIT Delhi, December 2021

Faiz Ali, Lakshman Neelakantan, and P. Swaminathan, "Flexible Electrochromic Displays via Room Temperature Oxidation of Electroless Nickel", **XXI International Workshop on Physics of Semiconductor Devices** (IWPSD 2021), IIT Delhi, December 2021

A. Sudha, A.M. Koshy, and P. Swaminathan, "Role of sintering temperature on the properties of tungsten oxide for gas sensing applications", **XXI International Workshop on Physics of Semiconductor Devices** (IWPSD 2021), IIT Delhi, December 2021

Nitheesh M. Nair, Mohammad Mahaboob Jahanara, Debdutta Ray, and P. Swaminathan, "Photoresponse of a printed transparent silver nanowire- zinc oxide nanocomposite", **XXI International Workshop on Physics of Semiconductor Devices** (IWPSD 2021), IIT Delhi, December 2021

Faiz Ali, Anirban Chakraborty, M. Prahalad, Lakshman Neelakantan, and P. Swaminathan, "Phosphorus Doped Nickel Oxide by Oxidation of Electro-less Nickel Thin Films", **International Conference on Thin Films & Nanotechnology: Knowledge, Leadership, & Commercialization**, IIT Delhi, August 2021

Aarju M. Koshy, A. Sudha, S.K. Yadav, and P. Swaminathan, "Effect of substrate temperature on the optoelectronic properties of DC magnetron sputtered copper(I) oxide films", **International Conference on Thin Films & Nanotechnology: Knowledge, Leadership, & Commercialization**, IIT Delhi, August 2021

FACILITIES

Impedance Analyzer

Make: Keysight

Model : E4990A

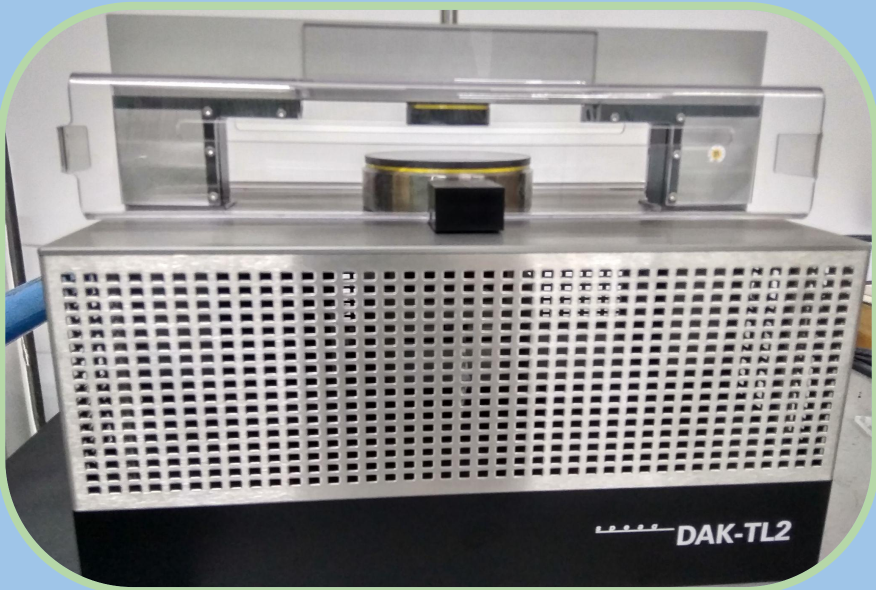
-20Hz to 20MHz

Dielectric Measurements of Thin Layers

Model: DAK3.5-TL-P

Frequency range : 200 MHz – 20 GHz

Make: Schmid & Partner Engineering AG (SPEAG), Zurich, Switzerland



FACILITIES

RRDE system with rotor glass shaft and cell

Make: Pine research Instrumentation

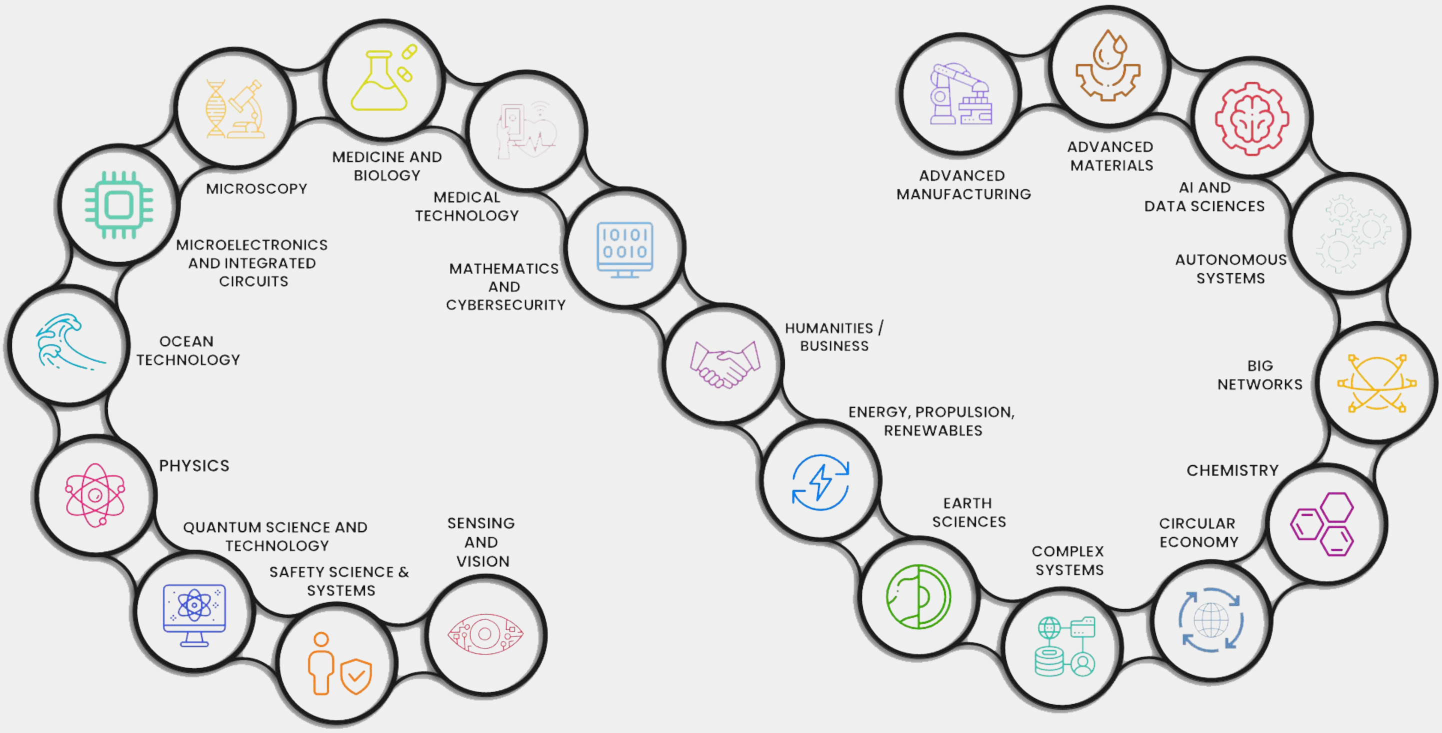
Model: WV10

Bipotentiostat with EIS facility

Make: Pine research Instrumentation
Model: WD200

CTFM

CERAMIC TECHNOLOGIES FOR FUTURISTIC MOBILITY



Materials and Manufacturing for Futuristic Mobility

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