DEPARTMENT OF
ELECTRONICS ENGINEERING

भारतीय प्रौद्योगिकी संस्थान
भारतीय खनि विद्यापीठ
धनबाद

IIT ISM INDIAN INSTITUTE OF TECHNOLOGY INDIAN SCHOOL OF MINES DHANBAD

Legacy that Inspires the Future

SPARK

MONTHLY e-NEWSLETTER

JUNE 2025
6th EDITION

INSIDE THIS **ISSUE**

See earlier iterations of the newsletter

FROM THE HOD'S DESK

Dear Readers,

We are here to update you about the overall progress and a few milestones achieved by the Department of Electronics Engineering in June 2025.

The month began with welcoming our new faculty members Prof. Preety Priya and Prof. Manoj Kumar to the department. Following this, our department hosted a Workshop on "Lumerical Simulation of Photonic Integrated Circuits (PICs) and Their Fabrication Strategies", coordinated by Prof. Mrinal Sen and co-coordinated by Prof. Mukul Kumar Das. Additionally, a GIAN Course on "Memristors and Their Applications in Neuromorphic Computation" was conducted under the coordination of Prof. Rajeev Kumar Ranjan. We also organized a Drone Bootcamp as part of the MeitY-funded project "Capacity Building for Human Resource Development in Unmanned Aircraft Systems". The event saw participation from over 120 students representing six states across India.

Additional highlight of the month was the 3rd IEEE International Conference on Microwave, Antenna, and Communication (MAC 2025), where Prof. Ravi Kumar Gangwar delivered a distinguished keynote address. Several research papers by our faculty members were also published in reputed journals, reflecting the department's ongoing academic contributions.

With mixed emotions, we bid a heartfelt farewell to Purin Marandi ji, who retired after an exemplary 34 years of dedicated service to our institution. Finally, we are excited to announce that a Global Initiative of Academic Networks (GIAN) Programme is scheduled to be held from November 3rd to 7th, 2025. We look forward to enthusiastic participation in this upcoming academic event.

Please find the Newsletter for detailed updates and give your valuable feedback to fertilize us to be bigger and better.

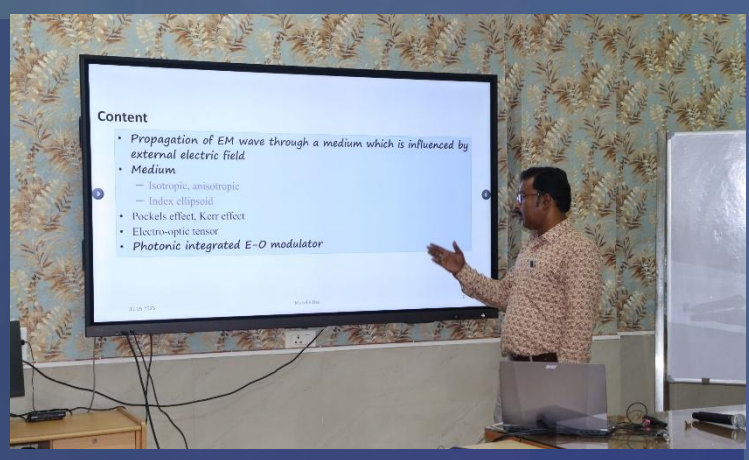
Wish you all the best!

Prof. Ravi Kumar Gangwar
HOD, Department of Electronics Engineering,
IIT(ISM) Dhanbad

A WORKSHOP ON

LUMERICAL SIMULATION OF PIC AND THEIR FABRICATION STRATEGIES

The Department of Electronics Engineering, IIT (ISM) Dhanbad, organized a 2-day workshop titled "Lumerical Simulation of Photonic Integrated Circuits (PIC) and Their Fabrication Strategies" in June 2025. The workshop covered key areas such as the basics of PICs, an introduction to Ansys Lumerical for PIC simulation, modeling of various common PICs and fabrication strategies for PICs. The event was coordinated by **Prof. Mrinal Sen (Coordinator) and Prof. Mukul Kumar Das (Co-coordinator)**, aimed to provide participants with hands-on experience and foundational knowledge in the rapidly growing field of photonic integration.



GIAN COURSE ON MEMRISTOR AND IT'S APPLICATION IN NEUROMORPHIC COMPUTATIONS

The Department of Electronics Engineering, IIT (ISM) Dhanbad, successfully conducted a prestigious **GIAN (Global Initiative of Academic Networks) course on "Memristor and its Application in Neuromorphic Computations"** from June 23 to June 27, 2025. The program brought together experts, scholars, and enthusiasts to explore the intersection of emerging memory technologies and brain-inspired computing.

The course was inaugurated on June 23 by **Prof. Sukumar Mishra, Hon'ble Director, IIT (ISM),** who highlighted the growing importance of neuromorphic engineering and the transformative potential of memristive devices in the design of future computational systems.

A major highlight of the course was the series of lectures delivered by **Prof. Sung-Mo (Steve) Kang**, a globally renowned authority in VLSI and neuromorphic systems and former Chancellor of the University of California, Merced. Prof. Kang delivered insightful lectures across multiple days, covering topics from fundamentals of memristors to their integration in neuromorphic computing architectures.

Additional expert lectures and tutorials were delivered by:

- Prof. Subindu Kumar and Prof. Mukul Kumar Das, IIT (ISM), on MOS devices and memristive device prospects.
- Prof. Rajeev Kumar Ranjan, course coordinator, on memristor emulator design and its practical applications.
- Mr. H.S. Jatana and Dr. Uday Khambete from SCL, Chandigarh, on CMOS process design and SoC-level implementation challenges.

The course concluded with an interactive test and discussion session, ensuring knowledge reinforcement and practical understanding. A total of 83 participants, including one international attendee from Saudi Arabia, took part in this intensive academic program. The diverse participation and high-level technical engagement made the course a memorable success. The week-long course brought together faculty, researchers, and students from across the country and abroad, aiming to build strong foundational knowledge and hands-on understanding of memristor technology and its applications in brain-inspired neuromorphic computing.

The session was held in hybrid mode, with participants joining both online and in person at J.C. Bose Hall and received an enthusiastic response from the academic community.

Prof. Sung-Mo (Steve) Kang

BOOTCAMP ON

ELECTRONICS FOR UNMANNED AERIAL SYSTEMS, SENSORS AND COMMUNICATION

The Electronics Engineering Department IIT-ISM Dhanbad, recently conducted a Drone Bootcamp (18–22 June 2025) under the MeitY-funded project “Capacity Building for Human Resource Development in Unmanned Aircraft Systems.” Over 120 students from six different states across India participated. They represented institutions such as IIT Patna, NIT Durgapur, NSUT Delhi, BIT Mesra, BIT Sindri, Manipal University, UCET Hazaribagh, IEM Kolkata, Gaya Engineering College, GEC Jamui, IIT Dhanbad and more.

Participants assembled, programmed and flight-tested 20 drones (8 hexacopters and 12 quadcopters), gaining hands-on experience in UAV fundamentals, aerodynamics, sensors, GPS, antenna design, communication systems, image processing, machine learning, control systems and embedded systems.

Congratulations to all who participated, their enthusiasm and teamwork truly made the difference!

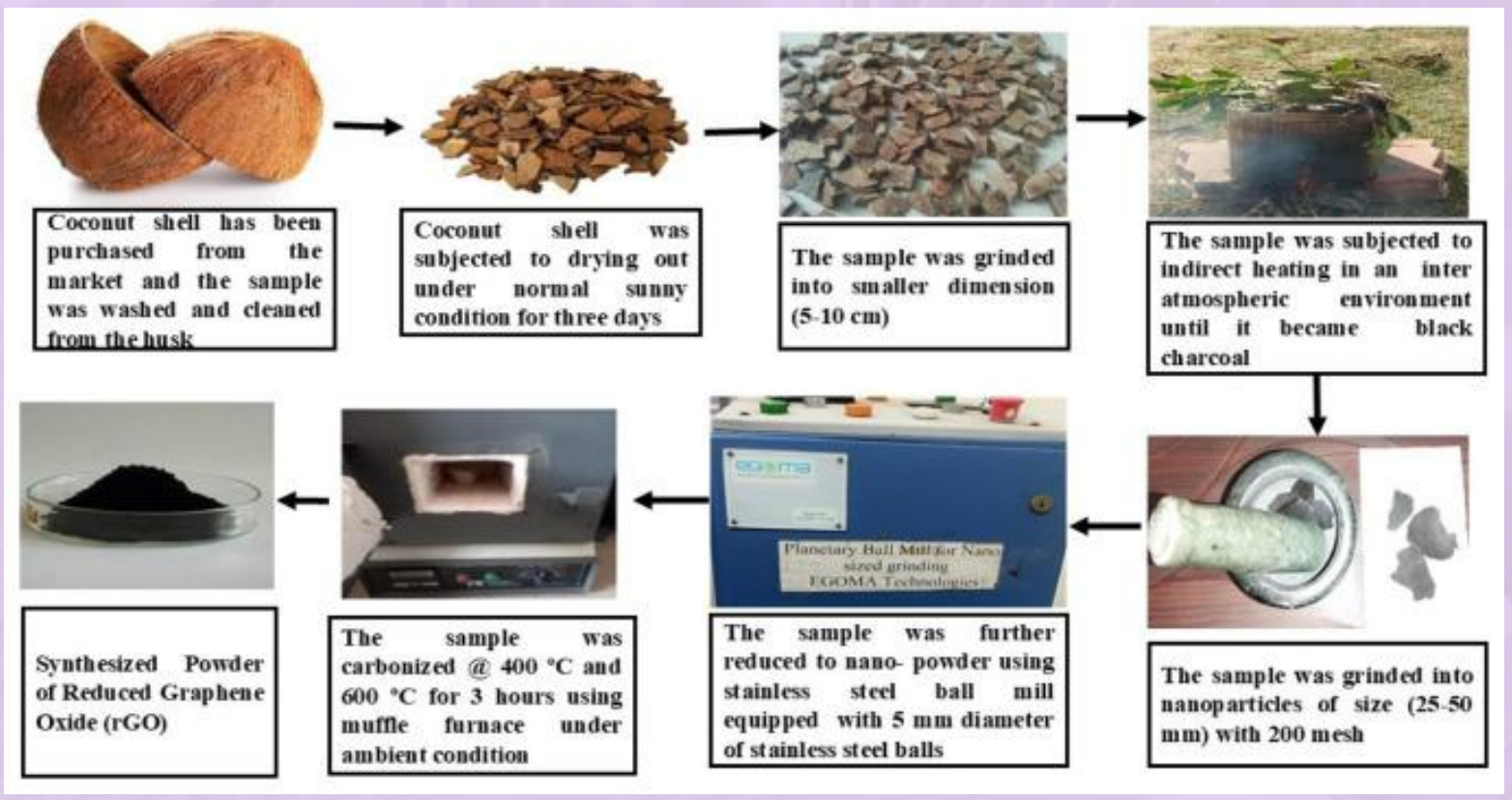
EXCHANGING **IDEAS AND INNOVATIONS**

Prof. Ravi Kumar Gangwar, HOD Department of Electronics Engineering, IIT (ISM) Dhanbad delivered a distinguished keynote address at the 3rd IEEE International Conference on Microwave Antenna and Communication (MAC 2025), held on 28 June at Maulana Azad National Institute of Technology (MANIT), Bhopal, Madhya Pradesh. The conference served as a prestigious forum for researchers, academicians, industry experts, and startup innovators to present their latest research findings, share knowledge, and articulate their vision for the future of microwave antenna and communication technologies. MAC 2025 incorporated dedicated tracks emphasizing the contributions of Young Professionals, Women in Engineering, and SIGHT, complemented by technical sessions addressing contemporary developments in the field.

PUBLICATION

Arti Kumari , Animesh Dubey, **Dr. Manodipan Sahoo** , R. Thangavel , has recently published a paper titled "*Eco-friendly synthesis and characterization of high quality reduced graphene oxide from dry coconut shells*", Materials Chemistry and Physics, **Elsevier publishers**, vol. 344, no. 131091.DOI

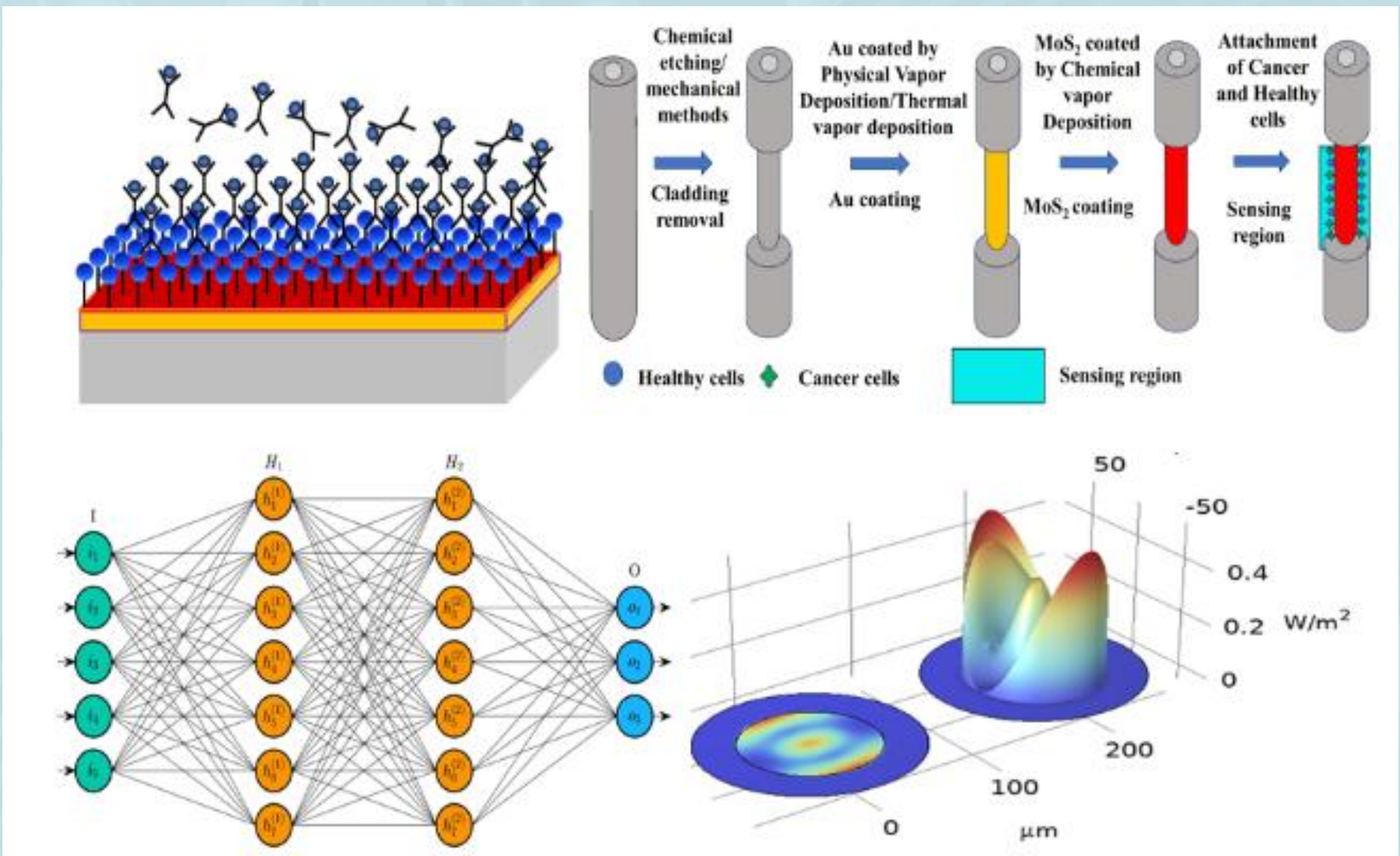
This work presents eco-friendly synthesis of high-quality reduced graphene oxide (rGO) from dry coconut shells through pyrolysis carbonization technique by heating at high temperatures (at 400 °C and 600 °C). The resulting material has been thoroughly characterized, revealing optical and electrical properties. The synthesized rGO demonstrates a significant specific surface area of 356.9783 m^2/g, featuring a small pore size division between 1.85 to 86.71 nm, with an average pore size of 31.76 Å. The material's properties like gas adsorption and semiconductor behavior are confirmed through various analytical techniques, including BET analysis, XRD, Raman spectroscopy, XPS, HRTEM, FTIR, and UV–Vis NIR spectroscopy. The UV–Vis NIR spectroscopy results show the optical energy band gap decreasing from 1.95 to 1.53 eV with rising temperature (400 °C to 600 °C), correlating with an increase in electrical conductivity from 289 to 400 µS/cm higher than the reported values in contemporary literatures. The heating at high temperature (600 °C) is found to yield the highest specific surface area and electrical conductivity. These findings demonstrate the successful synthesis of high-performance rGO from coconut shells, offering promising applications in various fields including Gas sensing, Biosensing, Optoelectronics and Semiconductor technology.



PUBLICATION

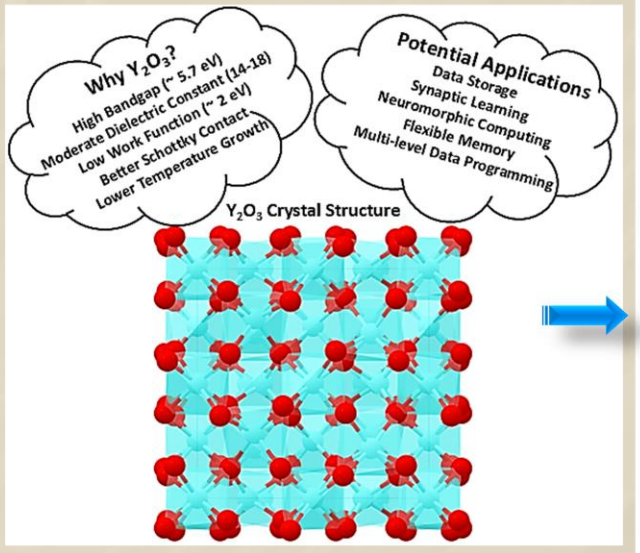
R. Rahul, A. Banerjee and **J. Thangaraj**, has recently published a paper titled "***Bayesian Regularized Neural Network based SPR Biosensor for Early Cancer Detection***," *IEEE Sensors Journal*. DOI

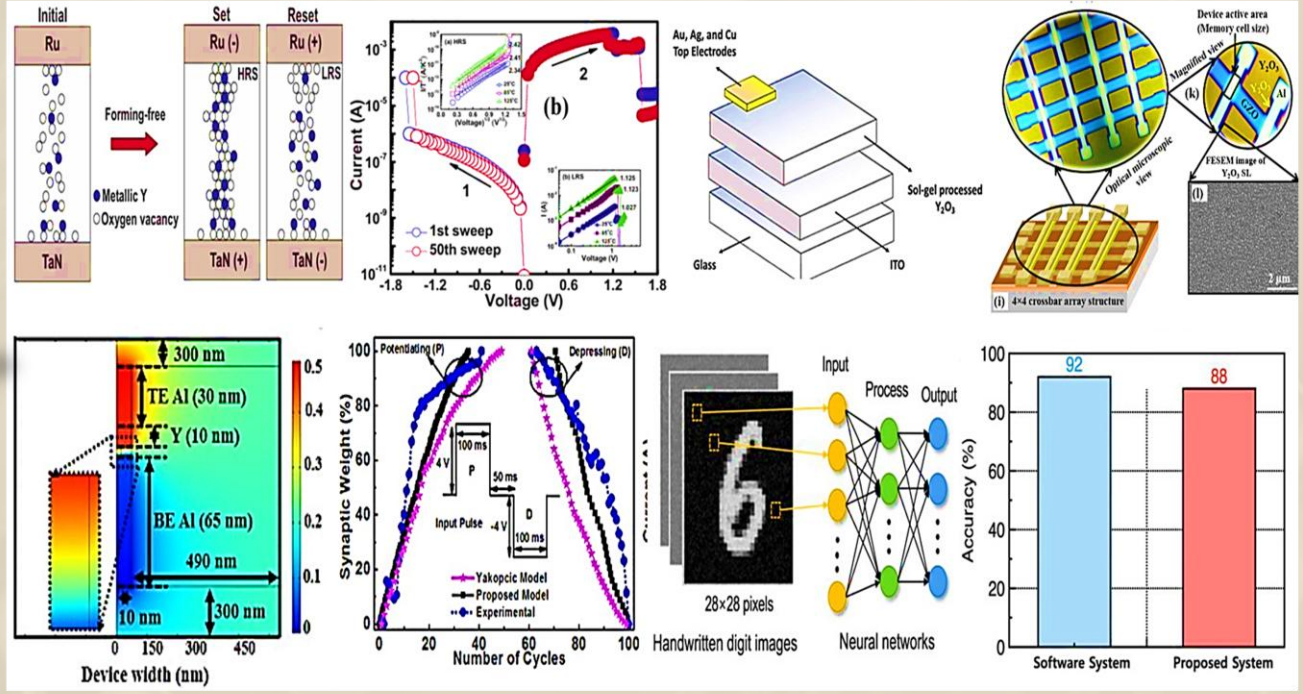
This paper investigates on biosensor utilizing surface plasmon resonance (SPR) mechanism, which provides improved sensitivity and capability for detecting cancer cells. The biosensor is composed of gold (Au) and molybdenum disulfide (MoS_2) as the sensing layers. Finite Element Method (FEM) is utilized in numerical analysis along with wavelength-interrogation technique to detect changes in the refractive index (RI) of human cells both normal and cancerous. Using Bayesian Regularization Artificial Neural Network (BRANN) models, parameters like mean square error (MSE) and R^2 were evaluated to determine the efficiency of the biosensor. The best MSE and R^2 values were obtained for the number of neurons (N) 45 i.e. 13.727482 and 0.999830, respectively. It can be used on more complicated structures to observe parameter correlation, cover a wide range of parameters, and achieve more accurate findings, especially with a high number of inputs and less time and computing effort. This biosensor exhibited a peak wavelength sensitivity (WS), quality factor (QF) and resolution (R) of 31428.57 nm/RIU, 106373.63 nm/RIU and 3.182×10^{-6} RIU for MCF-7 cell. Additionally, figure of merit (FOM) and detection accuracy (DA) of 271.43 RIU^{-1} for MDAMB-231 cell and 13.33 μm^{-1} for HeLa and Jurkat cells. The suggested technique has a lot of promise to enhance sensing capacity.



PUBLICATION

Aarti Dahiya, **Sanjay Kumar, Shalu Rani,** and Shaibal Mukherjee, published a paper titled"*Progress, Perspectives, and Future Outlook of Yttrium Oxide-Based Memristive Devices for Data Storage, Multibit Programming, and Neuromorphic Computing: A Systematic Review*" *ACS Applied Electronics Materials, 2025,* (IF: 4.7). DOI.





- Structural Engineering
- Doping
- Post annealing treatment
- Optical stimuli-driven switching properties
- Ion radiation

Experimental and physical modeling of Y_2O_3 based memristive device for memory and neuromorphic computing applications

Proposed strategies to improve the performance of Y_2O_3 based memristive devices and its crossbar array architecture.

Sanjay Kumar, Shalu Rani, "*Improved Performance of Yttrium Oxide-based Memristor through TiN Electrodes and Device Scaling for Neuromorphic and Pattern Recognition*" *IEEE Transactions on Materials for Electron Devices, 2025.* DOI

Existing challenges

The existing Y_2O_3 based memristive device suffers from large dimensions, which necessitate higher switching voltages, low ON/OFF ratio, short retention times, that limiting their low power neuromorphic computing functionalities to mimic the real brain activities.

Methodology

- Scaling down the physical dimension of device to improved the device performance.
- Electrode engineering (TiN is used as top and bottom contact).
- RF-Sputtering is used to fabricate the device.

Key findings

- Device Dimension = 10×10 μm²
- Endurance = 50,000 cycle
- Retention = 10^6 s
- ON/OFF ratio = 10^4
- Cycle to cycle variation = 4.95%
- Device to Device variation = 11.39%
- Neuromorphic characteristics (Synaptic behaviour, PPF, Potentiation/depression, PPD)
- Pattern recognition accuracy = 88.2%

Fig 1 (a) Dominant resistive switching mechanism in the fabricated devices, (b) Resistive switching responses of fabricated memristive device up to 1000 cycles, (c) Long-term endurance up to stable 50 k cycles, (d) Retention response up to 106 s, (e) The artificial neural network (ANN) architecture, and (f) Pattern classification accuracy

PUBLICATION

Sanjay Kumar, Deepika Yadav, Spyros Stathopoulos, Themis Prodromakis, published a paper titled "*Performance and variability analysis of ALD-grown wafer scale HfO_2/Ta_2O_5-based memristive devices for neuromorphic computing*", *Frontiers in Nanotechnology-Nanodevices*, *7*, 1621554, 2025, **(IF: 4.1)**. DOI

Existing Challenges

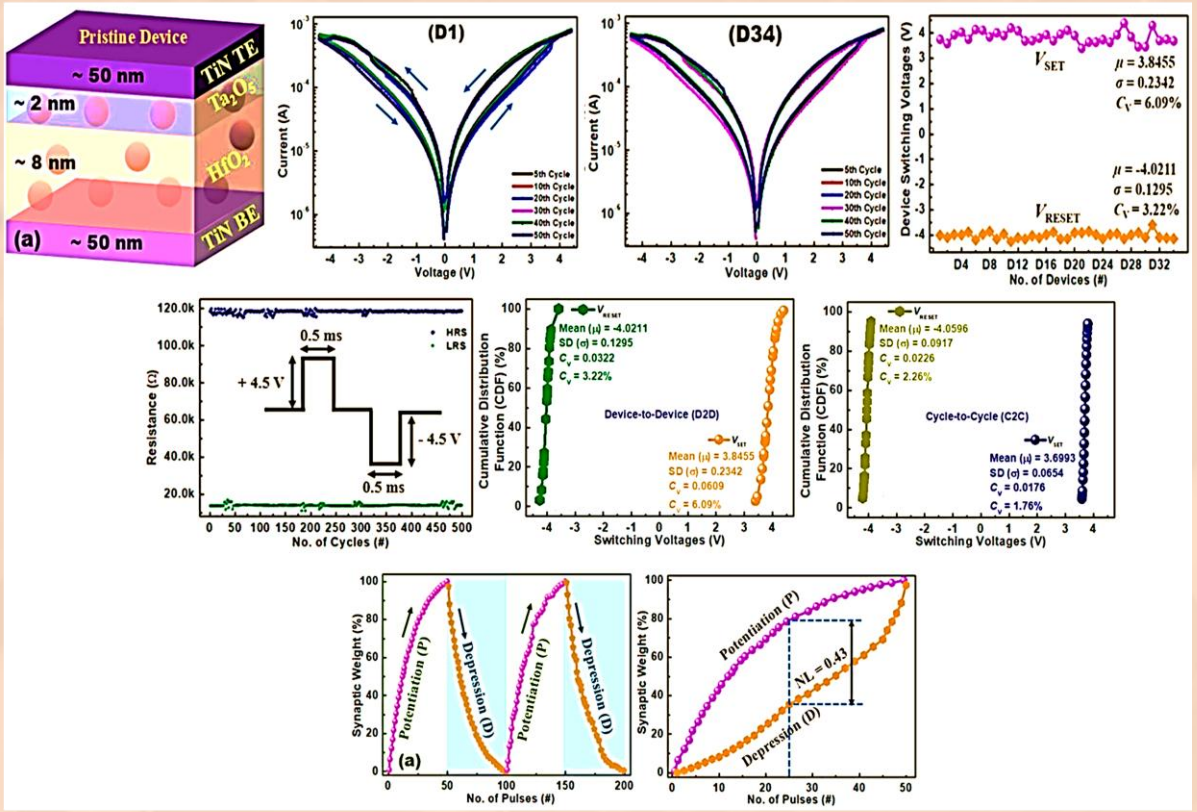
Due to the process variations and growth temperature difference, fabricated memristive devices exhibited high switching voltages (<10 V) with inconsistency in the resistive switching responses.

Methodology

- The ALD technique is used to deposit HfO_2/Ta_2O_5 layer.
- TiN Top and bottom electrode are deposited using Sputtering tool.

Key findings

- **Forming process** = required (V_{form}: +5.5 V)
- **Switching voltage** = (V_{SET} = +3.75 V), (V_{RESET} = -4.01 V)
- **Coefficient of Variability (Cv)** = V_{SET} : 1.76%, V_{RESET}: 2.26%



Shalu Rani, Gaurav Khandelwal, Abhinav Tandon, **Sanjay Kumar**, Akshaya Kumar Aliyana, Suresh C. Pillai, George K. Stylios, Nikolaj Gadegaard, Daniel M. Mulvihill, published a paper titled "*Flexible and twistable $ZnMn_2O_4$-electrodeposited yarn supercapacitors for wearable electronics*" *ACS Applied Materials & Interfaces, 2025,* **(IF: 8.2)**. DOI

Motivation

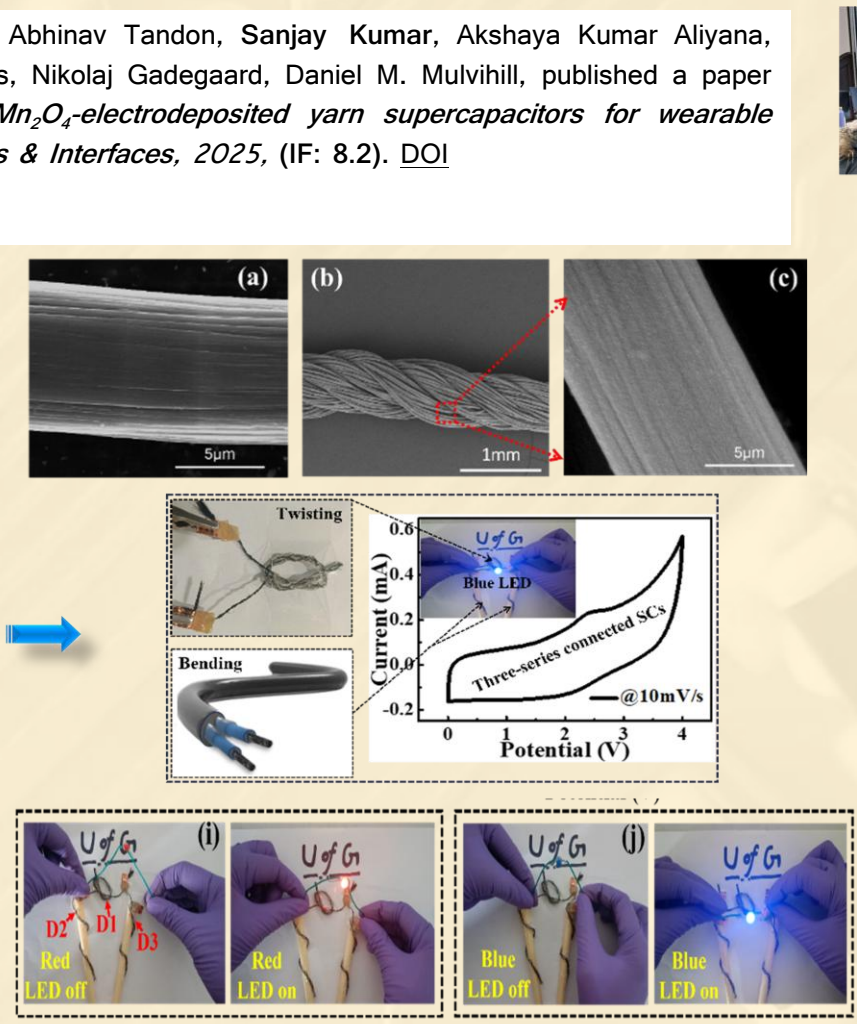
The utilization of ternary mixed transition metal oxides as an electrode material to develop flexible yarn SCs is rarely reported. These ternary metal oxides present promising alternatives to binary metal oxides due to their multiple oxidation states which contribute to high specific capacitance in energy storage applications

Methodology

- Electrodeposition technique has been used to grow $ZnMn_2O_4$ on flexible carbon yarn substrate.
- The flexible device was assembled using a gel electrolyte composed of PVA- H_3PO_4.

Key findings

- Areal capacitance of 87.6 mF/cm² at a scan rate of 10 mV/s and 35.4 mF/cm² at a current density of 0.1 mA/cm².
- The device maintained 92% of its original capacitance after 10,000 charge-discharge cycles with no significant performance degradation.
- The device successfully illuminated red and blue LEDs across different mechanical deformations, demonstrating consistent power delivery.



PUBLICATION

Swati Rajput and Adithya Sekhar,published a paper titled *"Controlled Hybridization of GaAs-based Vertically Coupled Hybrid Plasmonic Waveguide for Low-Loss Nanoscale Optical Confinement"*, **Optik**, Accepted, June 2025.DOI

Plasmonic waveguiding stands at the forefront of nanophotonic innovation, offering immense potential for the development of compact and efficient nanophotonic devices. Despite its promise, this field has faced challenges, particularly in managing significant propagation losses that hinder device performance and efficiency. Addressing this critical barrier, an engineered GaAs-based vertically coupled hybrid plasmonic waveguide (VCHPW) that leverages controlled hybridization to achieve ultra-low-loss nanoscale optical confinement. This innovative vertical coupling design enhances the interaction between plasmonic and dielectric layers, leading to superior mode confinement and substantially reduced propagation losses. The state-of-the-art design achieves remarkable performance, with ultra-low propagation losses of 0.004 dB/μm over a propagation length of 790 μm at a wavelength of 1.35 μm, and 0.0007 dB/μm over a propagation length of 5330 μm at a wavelength of 1.65 μm. Furthermore, the device exhibits a figure of merit ranging from 2280 to 5700. In comparison to conventional GaAs-based hybrid plasmonic waveguides, the proposed device demonstrates a reduction in loss by a factor of over 100. Additionally, it shows a significantly enhanced figure of merit and extended propagation length, marking an advancement in plasmonic waveguide performance. This meticulous engineering ensures that this VCHPW not only surpasses traditional hybrid plasmonic waveguides in terms of efficiency and confinement but also offers scalability and integration potential. These attributes are essential for future high-performance nanophotonic systems for communication and sensing technologies.

Vishal Kaushik, **Swati Rajput**, Ashavani Kumar, and Mukesh Kumar,published a paper titled *"Efficient Photodetection via High Aspect Ratio Core-Shell Nanowire Array"*,IEEE **Transactions on Nanotechnology**, Accepted, June 2025. DOI

Cu2O-ZnO-based high-aspect ratio core-shell nanowire (with radial p-n junction) for efficient photodetection via a cost-effective fabrication route. The proposed platform exploits enhanced active depletion area offered by radial p-n junction in high aspect ratio nanowires, along with this excellent transport properties of the device. This results in superior light-matter interaction and better charge collection efficiency. The proposed device demonstrates significant improvement in responsivity via a simple fabrication approach and offers a compact and cost-effective alternative to complex, highly sensitive photodetectors. It can find applications in remote sensing, medical diagnostics barcode readers, and wireless environmental monitoring. Moreover, the enhanced light-matter interaction via the proposed approach can be useful in various other applications such as Solar Cells, Light Emitting Diodes, and Optical Modulation.

Welcome

CONTACT

Department of Electronics Engineering, Room No. 206/B Indian Institute of Technology (Indian School of Mines) Dhanbad, Jharkhand, India, 826004.

E-mail: preetypriya@iitism.ac.in
Mobile: 8260344432

DR. PREETY PRIYA

Assistant Professor

Dr. Preety Priya has recently joined the Department of Electronics at IIT (ISM) Dhanbad as Assistant Professor. Prior to this, she served as Assistant Professor in the Department of Electronics and Communication Engineering at the National Institute of Technology, Calicut from March 2024 to May 2025. Before that, she worked as a Research Fellow in the Department of Electrical and Computer Systems Engineering at Monash University, Melbourne, Australia, from 2022 to 2024. Dr. Preety Priya completed her Ph.D. from the Indian Institute of Technology Kharagpur in 2022, following her MTech in Telecommunication Systems Engineering in 2014. Her academic contributions include 9 publications in IEEE journals, 3 in IEEE conferences, 2 granted Indian patents, and 1 granted US patent. Her research interests span mmWave MIMO wireless technology, sparse signal processing, nonlinear estimation, and OTFS systems. Notably, she was awarded the prestigious Qualcomm Innovation Fellowship in 2017.

We are delighted to have Dr. Preety Priya on board and look forward to her contributions to the department!

Welcome

DR. MANOJ KUMAR

Assistant Professor

Dr. Manoj kumar has recently joined the Department of Electronics at IIT (ISM) Dhanbad as Assistant Professor. Prior to this, he served as an Assistant Professor at LNMIIT Jaipur from July 2024 to June 2025. He holds a B.Tech in Electronics and Communication Engineering from Gautam Buddh Technical University, Lucknow (2012), an M.Tech in Electrical Engineering from IIT Kanpur (2015) and completed his Ph.D. in Electrical Engineering at IIT Delhi in 2024. Dr. Kumar's research spans exciting and impactful areas such as Graph Machine Learning, Optimization Algorithms, Graph Dimensionality Reduction, Federated Learning, and their wide-ranging applications.

We are excited to welcome Dr. Manoj Kumar to our academic community and eagerly anticipate the energy, expertise, and innovation he will contribute to the department.

CONTACT

Department of Electronics Engineering, Room No. 206/A Indian Institute of Technology (Indian School of Mines) Dhanbad, Jharkhand, India, 826004.

E-mail: manojkr@iitism.ac.in
Mobile: 8302241552

HAPPY Retirement

After a long and productive career there are very people who deserve to retire more than you do. I Hope you work just as hard at relaxing as you have in your long career!

Your hard work has leaf up to this point and now you can look forward to many years of doing what you want when you want

Tributes Pour In

As word of Mr. Purin Marandi's retirement spreads, heartfelt messages of gratitude and well-wishes pour in from colleagues.

"He was a quiet force in the department—always wearing a warm smile and never turning down a task," reflects Mr. Ravi Kumar Gangwar, Head of the Electronics Engineering Department. "Whether it was assisting students in the lab or helping with their final-year projects, he was always ready to lend a hand. His absence will be deeply felt by faculties, staffs, and students alike. We wish him a joyful retirement and continued good health in the years ahead."

"See ya later, May your days be filled with sunshine and zero deadlines."

"You can't retire from being great!"

"Getting paid to do nothing? Now that's retirement!"

Purin Marandi: A Look Back at 34 Years of Excellence

Since joining the Electronics Engineering Department at IIT(ISM) Dhanbad in 1991, Purin Marandi became an integral part of its fabric. His long journey as a Mechanic-B stands as a true testament to his unwavering dedication, quiet humility, and ever-helpful nature—qualities that earned him deep respect and admiration from colleagues across all levels.

A Fond Farewell to a Dedicated Colleague

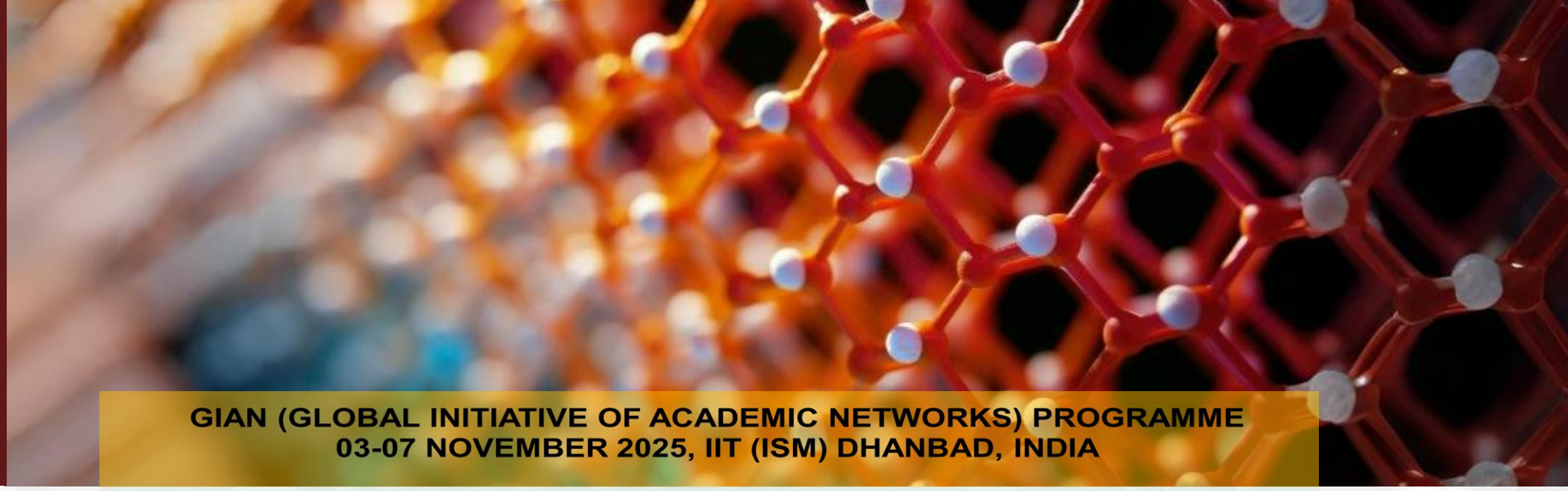
After 34 years ofimpeccable service, Mr. Purin Marandi is set to hang up his lab keys and step away from his working tools as he retires from his role as Mechanic in the Electronics Engineering Department at IIT(ISM) Dhanbad. Renowned for his precision and unwavering dedication, he has guided generations of students with unmatched skill and commitment.

"They say retirement is the golden years. Just don't spend all your gold before you run out of years!"

We'll miss your laughter and your smiles. You always managed to brighten up everyone's day.

To-do list for retirement :

1. Relax, 2. May be relax some more



GIAN (GLOBAL INITIATIVE OF ACADEMIC NETWORKS) PROGRAMME
03-07 NOVEMBER 2025, IIT (ISM) DHANBAD, INDIA

GLOBAL INITIATIVE OF ACADEMIC NETWORKS

Ministry of Education
Government of India
सत्यमेव जयते

2D Materials for Emerging Electronics

Guest Faculty

Prof. Ariel Ismach,
Dept. of Materials Science and Engineering,
Tel Aviv University, Israel

Host Faculty

Prof. Jeevesh Kumar,
Dept. of Electronics Engineering,
Indian Institute of Technology (ISM) Dhanbad, India

Course Coordinator:
Prof. Jeevesh Kumar,
Department of Electronics Engineering,
IIT (ISM) Dhanbad
Phone: +91 8884742131
Email: jeevesh@iitism.ac.in

Venue:
Department of Electronics Engineering, IIT(ISM) Dhanbad

Register by: 15/10/2025
Maximum Participants : 50
(First Come, First Service)

Scan for Registration

ONLINE GOOGLE FORM LINK FOR SUBMISSION WITH PAYMENT DETAILS IS PROVIDED BELOW

https://forms.gle/sfvG6rgnQ14h1RrA6

MEMORIES OF THE MONTH

WORKSHOP

GIAN COURSE

MEMORIES OF THE MONTH

DRONE BOOTCAMP @ IIT DHANBAD

FAREWELL