

SPARK

e-NEWSLETTER

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MAY 2026

DEPARTMENT OF ELECTRONICS ENGINEERING
INDIAN INSTITUTE OF TECHNOLOGY
(INDIAN SCHOOL OF MINES), DHANBAD





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HOD'S ADDRESS

Dear Readers,

It brings me immense pride to share some of our department's standout achievements and upcoming initiatives. Our community continues to push the boundaries of research, demonstrating excellence both in scholarly publications and on prestigious national platforms.

Our faculty members continue to make significant strides, contributing to the academic ecosystem through high-impact research and expert dialogues:

- **Invited Talk at IIT Guwahati:** Prof. Swati Rajput had the distinct honour of delivering an invited talk on "Heterogeneous Silicon Photonics for Next-Generation Optical Communication." This session was organized by the prestigious Department of Electronics and Electrical Engineering (EEE) at IIT Guwahati, highlighting our department's growing footprint in cutting-edge photonics research.
- **Research and Publications:** Our research culture remains robust, thanks to the continuous efforts of our faculty. I would like to commend Prof. R.K. Ranjan, Prof. M. Sahoo, and Prof. P. K. Varshney for their recent valuable publications in reputed journals, further advancing knowledge in their respective domains.
- **Congratulations to Prof. Ravi Kumar Gangwar** on receiving the 2026 Editorial Contribution Award from Springer Nature's *Scientific Reports* in recognition of his exceptional dedication to peer-review and academic excellence.

Looking Ahead: Driving Academic Excellence. In line with our commitment to national-level faculty development, our department will host an upcoming Two-Week Offline Refresher Course on "Device-Circuit Co-Design: From Emerging Materials to Intelligent Systems." Organized under the aegis of the Malaviya Mission Teacher's Training Programme (MMTTC) a premier UGC initiative, this program will take place from August 10-23, 2026.

I extend my heartfelt congratulations to our faculty achievers and offer my best wishes to the team coordinating the upcoming refresher course. Let us keep up this excellent momentum!

Wish you all the best!



Prof. Ravi Kumar Gangwar
HoD, Department of Electronics Engineering,
IIT(IISM) Dhanbad



EXCHANGING IDEAS AND INNOVATIONS



Delivered an
INVITED TALK
on
INTERNATIONAL DAY OF LIGHT
at **IIT GUWAHATI**



To mark the global celebration of the International Day of Light 2026, Prof. Swati Rajput had the honour of delivering an invited talk on “Heterogeneous Silicon Photonics for Next-Generation Optical Communication.”

The event was organized by the prestigious Department of Electronics and Electrical Engineering (EEE), IIT Guwahati, on 16 May 2026.

Key Takeaways from the Session:

Breaking Bottlenecks: Discussed how integrating distinct semiconductor materials onto silicon substrates can overcome the physical limits of traditional electronic interconnects.

Next-Gen Networks: Explored scalable, high-efficiency architectures designed to power the massive data demands of tomorrow's optical communication networks.

Collaborative Insights: Engaged in an energizing Q&A session with the faculty, researchers, and bright minds at IIT Guwahati, sparking brilliant conversations on the future of optoelectronics.

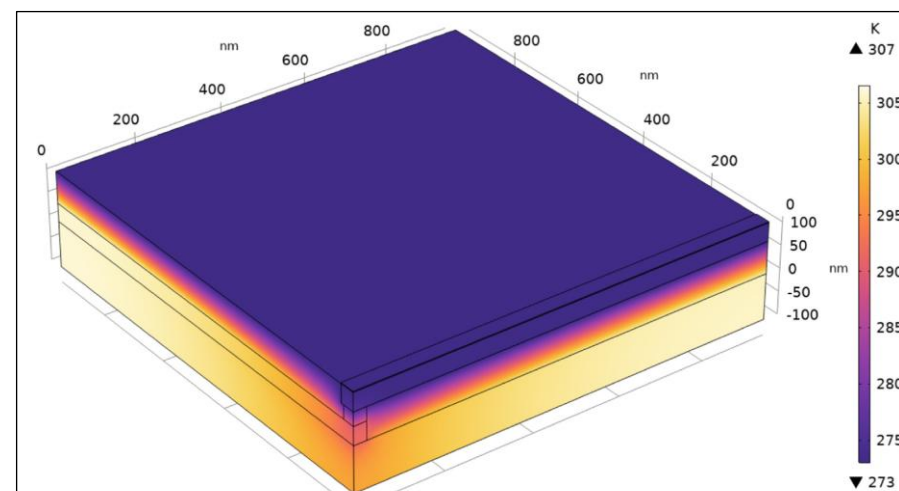
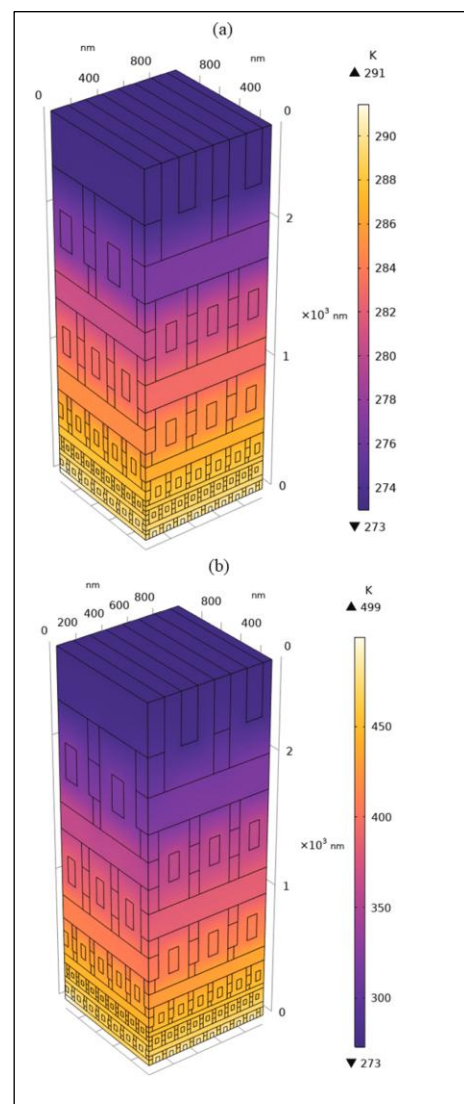
A huge thank you to the organizing committee at the Department of EEE, IIT Guwahati, for the gracious invitation and for hosting a phenomenal event that highlights the critical role of light-based technologies in shaping our future.

PUBLICATIONS

R. Verma, Jaiprakash, M. Sahoo, "*Electrothermal Modeling and Reliability Analysis of All-Carbon Interconnects: An Effective Medium Theory-based approach*" Micro and Nanostructures, Elsevier publishers, vol. 216, No. 208743, 2026.

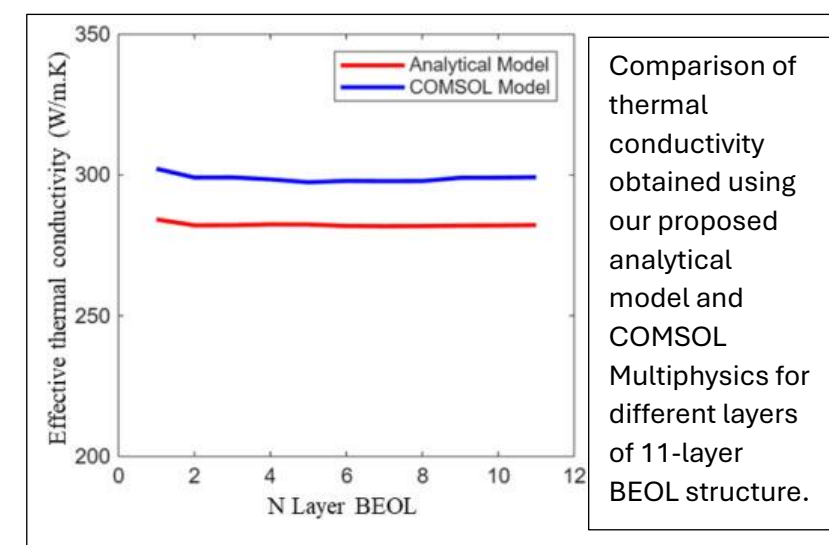
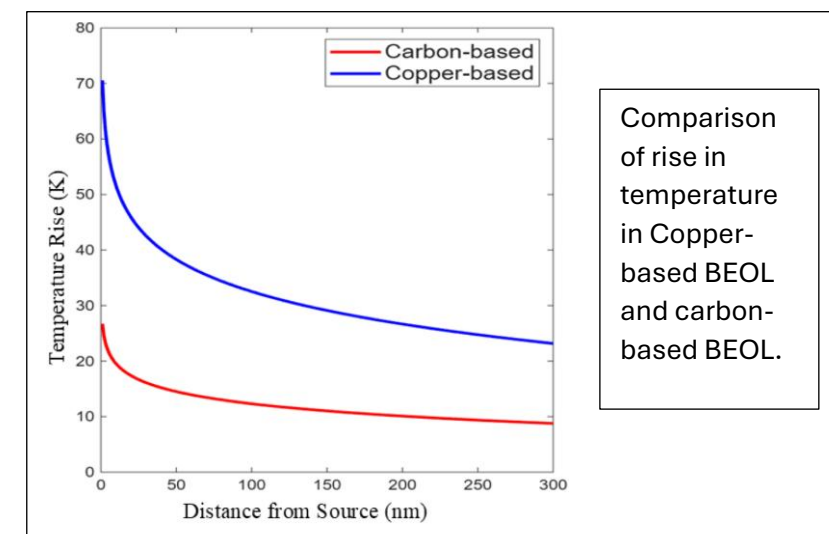
DOI: <https://doi.org/10.1016/j.micrna.2026.208743>.

The continuous scaling driven by Moore's Law has resulted in significant dimensional reductions at both the device and interconnect levels. However, conventional metal interconnects, particularly copper are increasingly challenged by performance degradation and reliability concerns at these nanoscale dimensions. Carbon-based materials such as carbon nanotubes (CNTs), graphene nanoribbons (GNRs), and graphene have emerged as promising alternatives due to their exceptional electrical conductivity, thermal performance, and mechanical robustness. In this study, we present an analytical model grounded in effective medium theory (EMT) to evaluate the electrothermal and reliability characteristics of a 11-layer carbon-based back-end-of-line (BEOL) interconnect structure at 14 nm technology node. The model incorporates composite vias composed of copper and CNTs, and GNR-based interconnects, integrated above a front-end-of-line (FEOL) structure over a silicon substrate. The analytical results are validated through finite element method (FEM) simulations using joule heating Multiphysics in COMSOL, demonstrating strong agreement between the two approaches with an error of less than 10%. The effective thermal conductivity (K_{eff}) of the proposed BEOL architecture and quantify the temperature rise under operating conditions using image charge theory. Furthermore, reliability is assessed by estimating the mean time to failure (MTTF). The findings indicate that the MTTF of the carbon-based BEOL structure is approximately ~ 1020 times greater than that of a conventional copper-based BEOL structure, underscoring the potential of carbon-based interconnects for nanoscale integrated circuits.



Heat flux flow between two ends of interconnects.

The flow of heat flux in the carbon based BEOL structure, (b) The flow of heat flux in the copper based BEOL structure (here, lighter area means more heat flux and higher temperature).

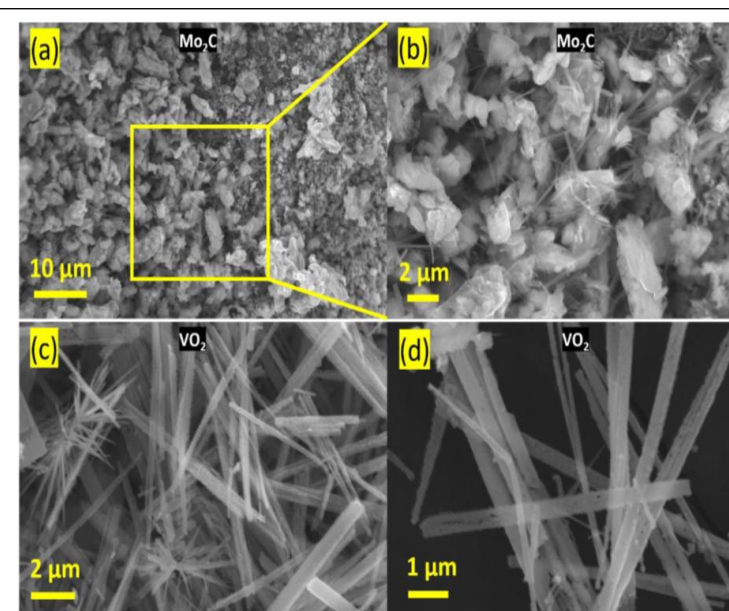


PUBLICATIONS

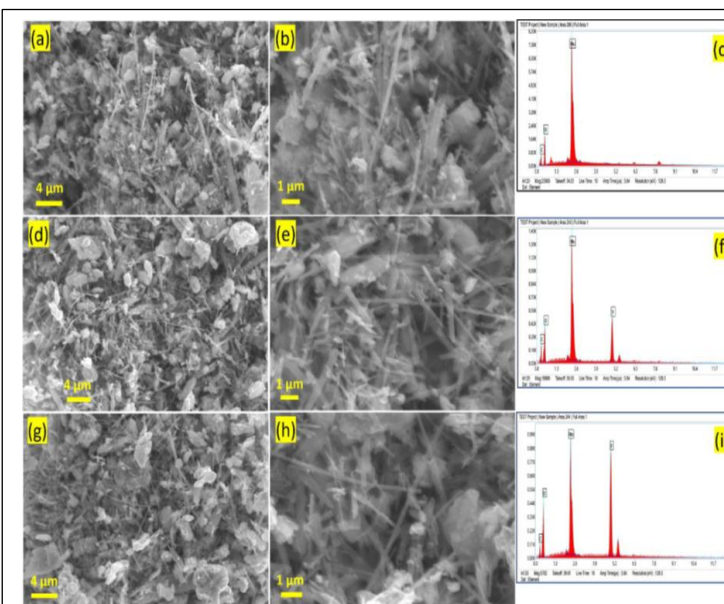
N. Kumar, S. Upadhyay, V. Gajraj, A. Sen, and R. K. Ranjan, “*Synergistic Oxide–Carbide Heterostructures of VO_2 and Mo_2C Enabling High-Performance Supercapacitor Electrode*” *Ceramics International*, 2026.

DOI: <https://doi.org/10.1016/j.ceramint.2026.05.431>

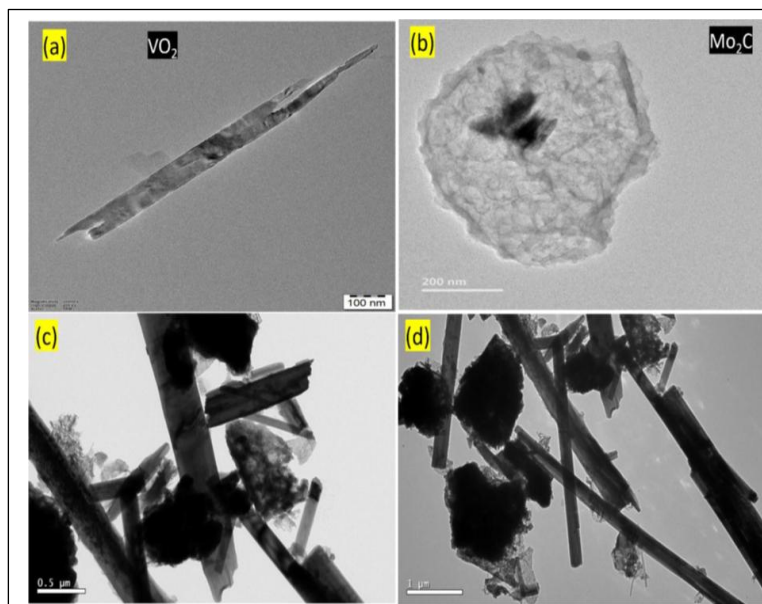
A novel VO_2 – Mo_2C heterostructured electrode was developed to enhance supercapacitor performance by combining the high redox activity of VO_2 with the excellent conductivity of Mo_2C . The optimised electrode achieved a high energy density of 101.9 Wh kg^{-1} and retained 82% of its capacitance after 10,000 cycles, demonstrating its potential for advanced energy storage applications.



SEM images (a, b) of Mo_2 at low and high magnifications, showing agglomerated Mo_2 particle with hi-erarchical morphology and (c, d) VO_2 showing rod-like VO_2 nanos-tructures.



SEM images of VO_2 – Mo_2 hybrid composites: (a, b) MV11, (d, e) MV21, and (g, h) MV311 at low and high magnifications, along with corresponding EDS spectra (c, f, i) confirming the presence of V, Mo, O, and C elements.

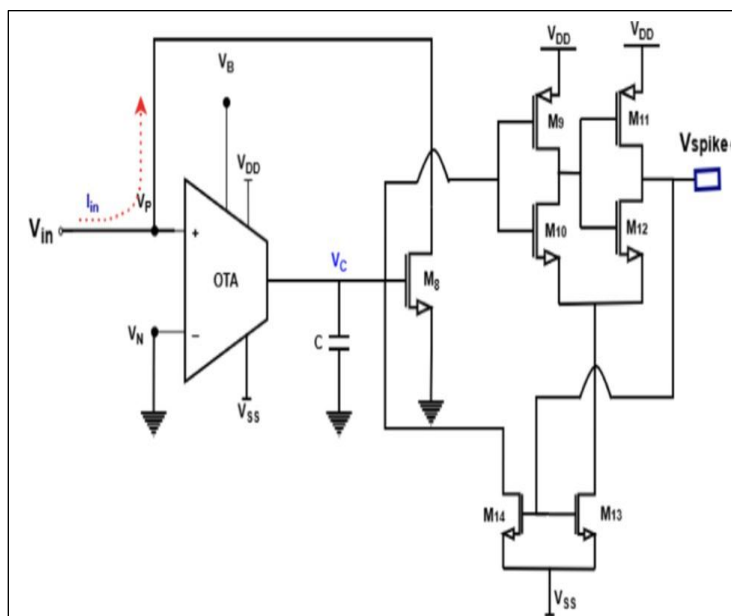


TEM images of the single VO_2 nanorod, (b) Mo_2 morphology and (c, d) MV21 composite at different magnifications, showing VO_2 nanorods decorated with Mo_2 domains

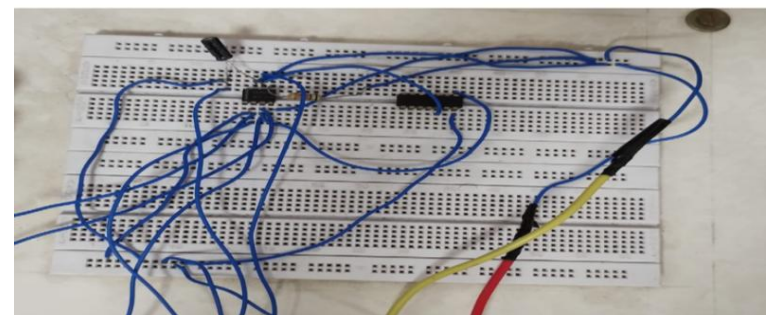
PUBLICATIONS

- K. Mondal, R. Kumar, B. S. Makhdoomi, Sagar, R. K. Ranjan, and S. Chandra, “*Flux-controlled memristor emulator for realizing adaptive intelligence*,” AEU – International Journal of Electronics and Communications, 2026.DOI:<https://doi.org/10.1016/j.aeue.2026.156398>.

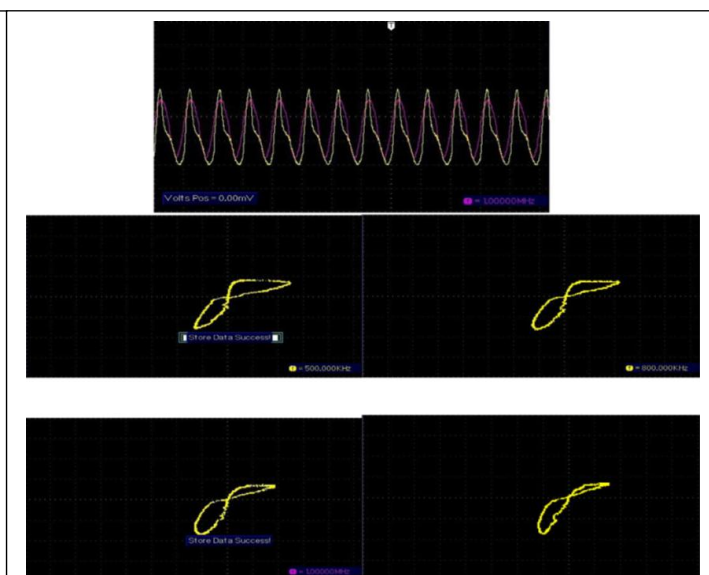
This work presents a high-frequency, resistor-less memristor emulator was developed using an OTA, a single NMOS transistor, and a capacitor, offering compact design, low power consumption, and operation up to 50 MHz at a 0.5 V supply. The proposed circuit demonstrated robust performance across frequency, temperature, and process variations, while successfully emulating biological memory behaviors and supporting neuromorphic neuron circuit design. Its practical feasibility was validated through both Cadence simulations and hardware implementation using CA3080 and CD4007UB ICs.



Proposed neuron circuit realized using the memristor emulator.



(a) Experimental setup for mem-ristor model (b) Memristor Proto-type on breadboard.



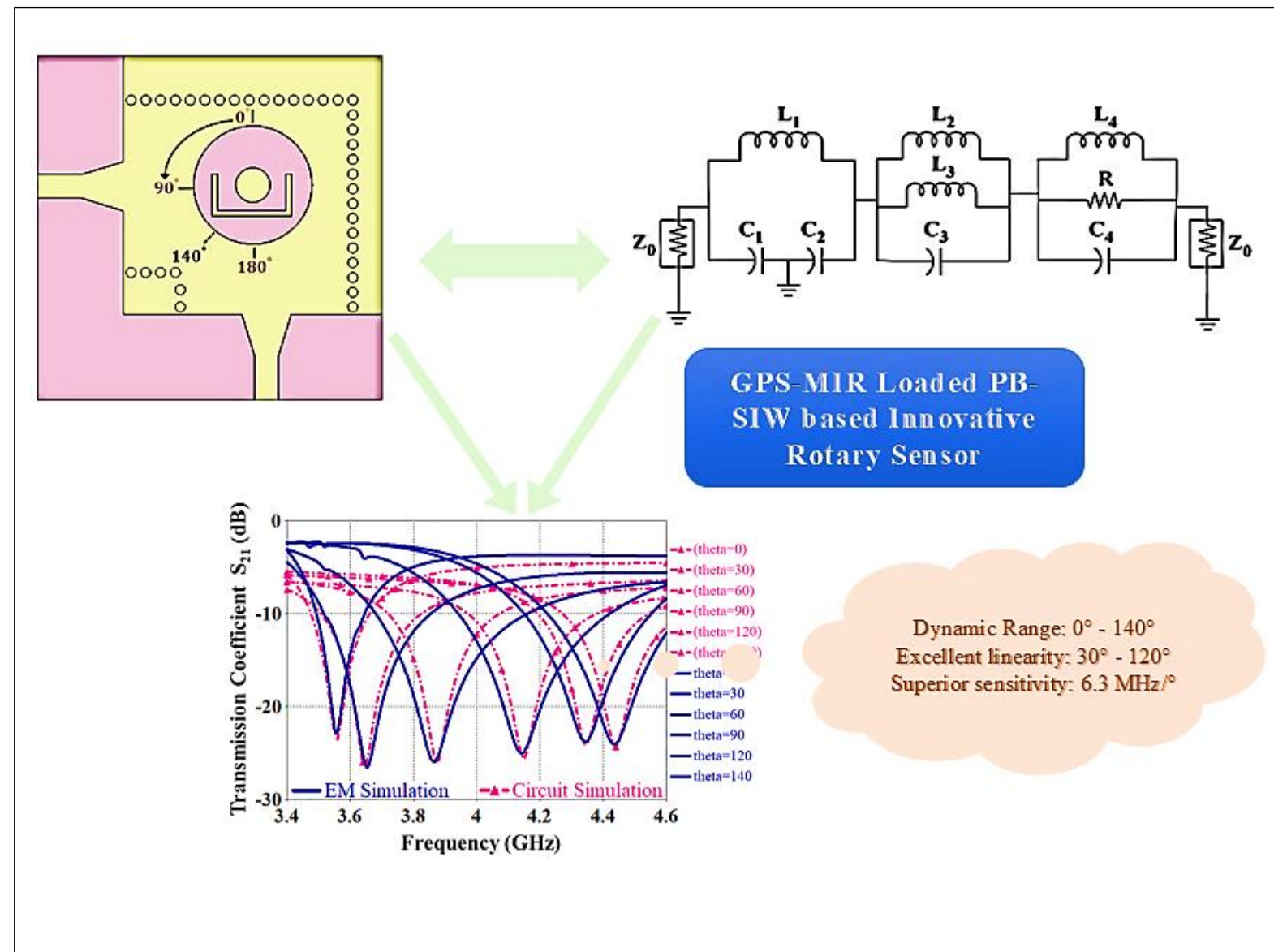
(a) Experimental transient I–V Characteristics of the memristor model at 1 MHz. Experimental pinched hysteresis loop at: (b) 500 KHz frequency, (c) 800 KHz frequency, (d) 1 MHz frequency, (e) 1.5 MHz frequency, respectively.

PUBLICATIONS

R. Prabha and P. K. Varshney, "A Novel Innovative Bi-complementary Resonator Coupled Advanced Substrate Integrated Waveguide Sensor for Angular Positioning Measurement," IEEE Sensors Journal, Early Access, 2026.

Doi: [10.1109/JSEN.2026.3685514](https://doi.org/10.1109/JSEN.2026.3685514)

Angular movement measurement systems play a pivotal role in several sectors including robotics, agriculture, automation, space, etc. where availability of low cost, durable, high performance rotary sensor is indispensable. Motivated with this, a novel rotary sensor introducing an innovative approach of designing a bi-complementary resonator coupled with an advanced substrate integrated waveguide (SIW), is unveiled in this work with excellent Figure-of-merits (FoMs) for angular positioning measurement. The rotary sensor primarily consists of 2 components – stator and rotor which work in conjunction for delivering the purpose. The stator element is an SIW derived structure designed through perpendicularly bent SIW (PB-SIW) engraving the location for rotor loading. The SIW is designed to operate for the fundamental propagation mode TE₁₀ with a cut-off frequency of 3 GHz. On the other hand, the rotor architecture is actually a bi-complementary structure with a creative Goal post shaped metamaterial-inspired resonator (GPS-MIR) being carved on both the faces of the substrate in complementary manner. Hence, the combination of both newly designed stator and rotor yields the proposed novel rotary sensor, operating at a resonance frequency of around 3.5 GHz, which is capable of performing within the dynamic range of 140° with an excellent linearity in almost the entire dynamic range. For validating the performance of the approach, a complete prototype is also fabricated and measurement is performed to display an agreement between simulated and practical versions. The proposed sensor is exhibiting a sensitivity of around 6.3 MHz/° which is substantially better from the previously available literature. In addition, an equivalent model analysis is presented to throw an insight around the actual physical understanding of the working methodology.



ACHIEVEMENT



We extend our heartfelt congratulations to Prof. Ravi Kumar Gangwar for being awarded the Editorial Contribution Award 2026. Prof. Ravi Kumar Gangwar has received the Editorial Contribution Award 2026 from Scientific Reports, a renowned journal published by Springer Nature. This esteemed accolade recognizes his exceptional dedication to the peer-review and editorial processes, which are crucial for upholding the quality, integrity, and progress of scientific research. The award signifies Prof. Gangwar's commitment to academic excellence and his substantial contributions to the global scientific community through his editorial work. Such recognition from one of the foremost scientific publishers in the world underscores his professionalism, expertise, and steadfast dedication to academic standards.

SPRINGER NATURE

springernature.com

Editor of Distinction Awards

Editorial Contribution Award 2026

This award is presented to

Ravi Kumar Gangwar

Scientific Reports

Ritu Dhand
Chief Scientific Officer,
Springer Nature



UPCOMING EVENT

**IIT(ISM)
DHANBAD**

**MALAVIYA MISSION
TEACHER'S
TRAINING PROGRAMME**
MMTTC – UGC INITIATIVE

OFFLINE REFRESHER COURSE

DEVICE-CIRCUIT CO-DESIGN
From Emerging Materials to Intelligent Systems
Two-week Offline Faculty Development / Refresher Course

**AUG
10-23
2026**

**Host Institute**
Indian Institute of Technology
(ISM) Dhanbad

**Venue**
Malaviya Mission Teacher Training Centre,
IIT (ISM) Dhanbad

**Registration Free**

**Application deadline: 31 July 2026**

**COURSE FOCUS**
A cross-layer journey from emerging materials and nanoscale device physics to reliable circuit and intelligent system design.

**Emerging devices** –
2D and carbon nanomaterial FETs

**Compact modelling** –
SPICE-ready device parameters

**Circuit reliability** – variability, leakage,
electro-thermal effects

**Intelligent systems** – low-power IoT
and system implications

**PARTICIPANTS WILL LEARN TO**

 Develop device-aware circuit designs

 Analyze cross-layer interactions
from materials to systems

 Integrate reliability-conscious strategies
into advanced electronic systems

**72**
contact
hours

**48+24**
lecture +
hands-on

**CAS /
UGC**
recognized

**MCQ**
assessment

**Certificate**
on successful
completion

**HANDS-ON EXPOSURE**

**SPICE**
simulations

**MATLAB-based**
modelling

**TCAD**
demonstrations

**Project work**
and activities

**ELIGIBILITY**
Faculty members of universities and colleges under UGC
Section 2(f). For Refresher Course admission, FIP participation
is a prerequisite and a one-year gap after FIP is required.

**RESOURCE PERSONS & EXPERT POOL**
Eminent experts from IIT Roorkee, IIT Kharagpur, IIT BHU, IIT Ropar, IIT Patna, IIT Madras,
IIT Kanpur, IIT Guwahati, IIT Indore, IIT Delhi, IIT Gandhinagar, IIITDM Kancheepuram,
IISc Bangalore, CSIR-CGCRI, Synopsys, ISRO/SCL and IIT (ISM) Dhanbad.

**APPLY ONLINE**
Register at mmc.ugc.ac.in, select Refresher Course,
choose Indian School of Mines (Jharkhand)
(10/08/2026–23/08/2026), upload approved NOC,
and submit.

**Scan to Register**

**COURSE COORDINATORS**

Prof. Manodipan Sahoo
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Prof. Rajeev Kumar Ranjan
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 www.iitism.ac.in

The Indian Institute of Technology (ISM) Dhanbad, under the aegis of the Malaviya Mission Teacher's Training Programme (MMTTC – a UGC Initiative), is organizing a two-week offline Faculty Development / Refresher Course titled "Device-Circuit Co-Design: From Emerging Materials to Intelligent Systems." Scheduled from August 10–23, 2026, at the IIT (ISM) Dhanbad campus, this course offers a comprehensive cross-layer journey from emerging materials and nanoscale device physics to reliable circuit and intelligent system design.

Key Highlights of the Program:

- **Immersive Curriculum:** 72 contact hours consisting of 48 hours of lectures and 24 hours of interactive hands-on sessions.
- **Practical Exposure:** Deep-dive training into SPICE simulations, MATLAB-based modelling, TCAD demonstrations, and collaborative project work.
- **Expert Pool:** Lectures and mentorship from eminent industry and academic experts hailing from premier IITs, IISc Bangalore, CSIR-CGCRI, ISRO/SCL, and Synopsys.
- **Recognition:** CAS / UGC recognized program with an MCQ assessment and certification upon successful completion.

Eligibility: The course is open to faculty members of universities and colleges under UGC Section 2(f). For Refresher Course admission, FIP participation is a prerequisite, along with a mandatory one-year gap post-FIP.

Important Information:

- **Course Dates:** August 10 – 23, 2026
- **Registration Fee:** Free
- **Application Deadline:** July 31, 2026
- **How to Apply:** Register online at mmc.ugc.ac.in, select 'Refresher Course', choose 'Indian School of Mines (Jharkhand)' (10/08/2026–23/08/2026), and upload your approved NOC.

For queries, please contact the Course Coordinators:

- **Prof. Manodipan Sahoo** | manodipan@iitism.ac.in | +91-9523625566
- **Prof. Rajeev Kumar Ranjan** | rajeev@iitism.ac.in | +91-9471191517

Dr. Aman Sikri

Assistant Professor

Research Interest: Reconfigurable Intelligent Surfaces (RISs), Non Orthogonal Multiple Access (NOMA), Free Space Optical (FSO) Communications, Rate Splitting Multiple Access (RSMA).

**Dr. Himanshu Bhusan Mishra**

Associate Professor

Research Interest: Development of Physical Layer Signal Processing for 5G/6G Wireless Technologies (OFDM, Massive MIMO, OTFS, RIS, ISAC etc.), Implementation of Physical layer algorithms on Software Defined Radio (SDR) based point-to-point wireless setup.

**Dr. Debjani Mitra**

Professor

Research Interest: Wireless Communication- 5G technologies, Communication Networks, Machine Learning and Statistical Signal processing.

Dr. Samrat Mukhopadhyay

Assistant Professor

Research Interest: Online Machine Learning, Compressed Sensing, Nonconvex and Stochastic Optimization, Sparse Adaptive Filtering.

**Dr. Govind Murmu**

Assistant Professor

Research Interest: Signal Processing and Communication Algorithms, Adaptive Filters, Adaptive Beamforming for 4G/5G, Blind Source Separation (BSS) Algorithms, Adaptive Control.

**Dr. Subhadeep Mondal**

Assistant Professor

Research Interest: Quantum computing, machine learning, signal processing, and next-generation communication systems, with an emphasis on developing mathematically grounded algorithms that bridge theory and real-world applications

**Dr. Preety Priya**

Assistant Professor

Research Interest: Integrated Communications and Sensing, High Mobility Communications, Leo Satellite Communications, OTFS, OFDM, Beamforming, MIMO, Sparse Signal Processing, Synchronization and Channel Estimation, Nonlinear Data Detection (Particle Filter).

Dr. Ugrasen Singh

Assistant Professor

Research Interest: Design and analysis of wireless communication systems. I have been working on Space Modulation Techniques (SMTs), Reconfigurable Intelligent Surface (RIS), Non-Orthogonal Multiple Access (NOMA), Orthogonal Frequency Division Multiplexing (OFDM), Ultra-Reliable and Low-Latency Communication (URLLC), and Physical Layer Security.

**Dr. Nirupama Mandal**

Associate Professor

Research Interest: Transducer Design, Controller Design, Instrumentation System Design, Smart Sensing System and Smart Instrumentation.

**Dr. Mrinal Sen**

Associate Professor

Research Interest: Photonic Integrated Circuits, Embedded Systems.

FACULTY PROFILE

Dr. Sushrut Das

Professor

Research Interest: Microwave Passive Networks, Antennas, Wireless Energy Transfer and Energy Harvesting Microwave Filters.**Dr. Ravi Kumar Gangwar**

Professor

Research Interest: Dielectric Resonator Antennas, MIMO Antennas, Bio-electromagnetics And Microwave Measurements.**Dr. Santanu Dwari**

Professor

Research Interest: RF & Microwave Engineering, Antenna.**Dr. Prashant Kumar Varshney**

Assistant Professor

Research Interest: SIW Based Microwave Planar Sensors, Metamaterial Inspired Microwave Sensors for Various Applications.**Dr. Y. M. Asha Latha**

Assistant Professor

Research Interest: RF Power Amplifier Design: Broadband, High Efficiency, Switched Mode PAs, Harmonic Manipulation, Harmonic Injection, Load Modulation, Doherty PA, Chip Design: GaN MMIC Based RF Power Amplifier Design.**Dr. Amitesh Kumar**

Associate Professor

Research Interest: Photonic Integrated Circuits, Fiber Optic Sensors, Microwave Photonics, and Radio-over Fiber Technologies for 5G and Beyond.**Dr. Jaisingh Thangaraj**

Associate Professor

Research Interest: Optical Networks, Wireless Sensor Networks, VANET, Software Defined Networks, Optical Instrumentation.**Dr. Devendra Chack**

Associate Professor

Research Interest: Photonic Integrated Circuits, Advance Optical Communications, Radio-over-Fiber System For 5G/6G.**Dr. Jitendra Kumar**

Professor

Research Interest: Nano-optoelectronics, Nanoelectronics.**Dr. Mukul Kumar Das**

Professor

Research Interest: Modeling and Design of Semiconductor Devices for VLSI and Opto-electronic Applications, Growth of Semiconductor Interface and Band-gap Engineered Thin Film Transistor and Solar Cell by using PVD Technique, Design and Development of Integrated Modules for Photonic QKD Network Development of Quantum Fiber Optic Network.

FACULTY PROFILE

Dr. Naresh Sharma

Assistant Professor

Research Interest: Integrated Photonics, Programmable Photonics, Free Space Optics, Photonic Crystals Applications.



Dr. Sanjeev Kumar Raghuwanshi

Professor

Research Interest: Numerical Method of Optical Waveguides, Optical Sensor, Microwave Photonics, Optical Fiber Communication.



Dr. Swati Rajput

Assistant Professor

Research Interest: Silicon Photonics for Next Generation Optical Communication, Nano photonics, Semiconductor Optoelectronics.



Dr. Jeevesh Kumar

Assistant Professor

Research Interest: 2D Materials, Emerging Electronic Devices, Atomistic Simulation, Device Fabrication, material & Device characterizations.



Dr. Shalu Rani

Assistant Professor

Research Interest: Energy Storage Devices for Wearable Electronics Including Advanced Flexible Supercapacitors/Micro-supercapacitors.



Dr. Subindu Kumar

Professor

Research Interest: III-V Semiconductor Nano-structures, Nano-scaled MOS Devices and Circuits, On-Chip Interconnects.

Dr. Rajeev Kumar Ranjan

Associate Professor

Research Interest: VLSI Design, Mem-element (Memristor, Memcapacitor, And Meminductor) Design.



Dr. Manodipan Sahoo

Associate Professor

Research Interest: 2D Materials-based Devices and Circuits, Nanomaterials based Sensors, Heterogeneous 3D ICs, Neuromorphic Circuits.



Dr. Rahul Bhattacharya

Assistant Professor

Research Interest: Modelling Of Analog and Mixed-signal Circuits, Fault Modeling and Testing of VLSI Circuits, FPGA-based Design.



Dr. Kaushik Mazumdar

Associate Professor

Research Interest: VLSI Design, Electronic Low Dimensional Systems, Analysis and Design of MOSFET & Nano-Devices.



Nanoelectronics and VLSI



OPPORTUNITY

In the Department of Electronics Engineering at IIT (ISM) Dhanbad, applications are being accepted for both full-time and part-time Ph.D. programs.

Application form, Guidelines, Terms & Conditions for full-time are available at IIT(ISM) Dhanbad website.

https://admissions.iitism.ac.in/phd/index.php/admission/add_phd/home

ENGINEERING PROFESSIONALS APPLY

The Department of Electronics Engineering at IIT (ISM) Dhanbad is seeking highly motivated research personnel for multiple ongoing projects in cutting-edge domains such as 6G Communication, VLSI Design, MEMS, and Signal Processing. Applications are invited for various positions, including Junior Research Fellows (JRF) and Project Associates

Application form, Guidelines, Terms & Conditions for full-time are available at IIT(ISM) Dhanbad website.

<https://people.iitism.ac.in/~research/Projectopening.php>



Working at the Department of Electronics Engineering offers access to state-of-the-art laboratory facilities, a collaborative research environment, and the opportunity to enroll in a Ph.D. program (subject to departmental norms and performance).

EDITORIAL TEAM

Dr. Jeevesh Kumar, Mr. Bappa Ghosh, Mr. Vaibhav

[LinkedIn](#) [Website](#)

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