Website Information
Department of Physics
Dayananda Sagar University

Faculty details:

Item	Details
Faculty Name:	Dr. P.R. SEKHAR REDDY
Room No:	A-224
Designation:	Assistant Professor
E-mail:	sekharreddy-phy@dsu.edu.in ; drsekharreddy1@gmail.com
Research Area:	Semiconductor Materials and Device Characterization, Ferroelectric-Based Non-Volatile Memory Devices, Schottky diodes, RRAM, FeRAM, Synaptic and Neuromorphic Devices
Publications (Past 5 Years)	1. Advancements in Artificial Synapses: The role of Fluorite–Structured Ferroelectrics". **P.R. Sekhar Reddy** ***Nano Trends Nano Trends*** **9 (2025) 100074.** 2. "Light Trapping on Silicon Substrates via non-Uniform Discorded Dendrites for Water Splitting and CO2 Reduction Applications" Poshan Kumar Reddy K., Prasanna Lakshmi B., Sarma G.V.S.S, P.R. **Sekhar Reddy**. ***Applied and Advanced Materials*** **(2024) 1-7.** 3. Review on Next-Gen Healthcare: The Role of MEMS and Nanomaterials in Enhancing Diagnostic and Therapeutic Outcomes8. B Nagarjuna Reddy, S. Saravanan, V. Manjunath and **P. R. Sekhar Reddy** ***Biomaterials Connect,*****1,004 (2024) 1-12.** 4. Effects of Zn doped MoO3 nanocomposite interlayer on electrical and surface chemical state properties of Ni/Cr/n-GaN Schottky Junction V. Manjunatha, C.K Kunapalli, M. Vanic, R. Jaya Madhuric, S.A Ragabd, Mohammad Rezaul Karim, N. N.K. Reddy, K. Munirathnam, **P.R. Sekhar Reddy**, S. H. Kumar, Tae J. Koi, N. G Prakash, P. Rosaiah, ***Materials Science & Engineering B*** **(2024) 117602**. 5. A Review of Transforming Neuromorphic Computing with 2D Material Memtransistors". P.R. Sekhar Reddy ***Micromaterials and Interfaces*** **2,1 (2024)1-15.** 6. Enhanced Remnant Polarization in Ferroelectric Hf0.5Zr0.5O2 Thin

Film Capacitors Through Mo Top Electrode Post-Metallization Annealing”.
P.R. Sekhar Reddy, N.V Raveendra and Adem Sreedhar
***Physica B: Condensed Matter* 685 (2024) 416024.**

7. Microstructural and current-voltage characteristics in Mo/HfO2/n-Si based metal-insulator-semiconductor (MIS) diode using different methods for optoelectronic device applications
G. Nagaraju, N.V. Srihari, M. Renuka, B. Rajitha, S. Basamma, S. H. Kumar, **P. R. Sekhar Reddy**, M. Vani R. J. Madhuri, V. Manjunath
***IJFMR-International Journal of Multidisciplinary Research*, 6,2, 1-13, 2024.**

8. Structural and electrical characteristics of Zr-doped HfO2 (HZO) thin films deposited by atomic layer deposition for RRAM applications
P.R. Sekhar Reddy
***Micromaterials and Interfaces,* 1,1, 2023.**

9. Enhanced Resistive Switching Properties of the HfAlOx/ZrO2 -based RRAM devices**.**
P.R. Sekhar Reddy, N. V Raveendra, Y Anil Kumar and G Murali
Progress in Natural Science: Materials International 32 (2022) 602–607

10. Annealing Effect on the Structural, Optical, Electrical, and Current Transport Properties of Au/CuPc/n-Si Organic-Inorganic Schottky barrier diode.
P.R. Sekhar Reddy, V. Janardhanam, V. Rajagopal Reddy, M. H. Park and C. J. Choi.
***Applied Physics A* 127:803 (2021) 1-12.**

11. Study Domains and Domains Dynamics in Fluorite-Structure Ferroelectrics**.**
Dong-Hyun Lee, Young Hwan Lee, Kun Yang, Ju-Yong Park, **P.R. Sekhar Reddy**, Thomas Mikolajick, Jacob Jones, U. Schroeder, and Min Hyuk Park.
***Applied Physics Reviews* 8, (2021) 021312.**

12. **An Advanced Nano-sticks & Flake-type Architecture of Manganese-cobalt Oxide as an Effective Electrode Material for Supercapacitor Applications.**
H.J Kim, B Naresh, I.H Hee-Je Kim, Bandari Naresh, In-Ho Cho, Jin-Soo Bak, Shamim Ahmed Hira, **P.R. Sekhar Reddy**, TNV Krishna, K D Kumar, B. A. Mola, Yedluri Anil Kumar
***Journal of Energy Storage* 40, (2021) 102702.**

	13. A Perspective on Semiconductor Devices Based on Fluorite Structured Ferroelectrics from The Materials-Device Integration Perspective. **J. Y**. Park, K. Yang, D. H. Lee, S. H. Kim, Y. H. Lee, **P. R. Sekhar Reddy**, J. L. Jones, and M. H. Park. ***Journal of Applied Physics* 128, (2020).** 14. Temperature-Dependent Schottky Barrier Characteristics of Al/n-type Si Schottky Diode with Au-CuPc Interlayer **P.R. Sekhar Reddy,** V. Janardhanam, Kyu-Hwan Shim, Sung-Nam Lee, A. Ashok Kumar, V. R. Reddy, and Chel Jong Choi. “. ***Thin Solid Films* 713, (2020) 138343.** 15. CoCu2O4 Nanoflowers Architecture as an Electrode Material for Battery Type Supercapacitor with Improved Electrochemical Performance**.** Young-Seok Lee, Yedluri Anil Kumar, S. Sambasivam, Shamim Ahmed Hira, Kamran Zeb, Waqar Uddin, **P.R. SekharvReddy**, K. D. Kumar, Ihab M. Obaidat, Hee-Je Kim, Sung shin Kim. **Nano-Structure & Nano-objects, 24 (2020) 100618.** 16. Schottky Barrier Parameters and Low-Frequency Noise Characteristics of Au/Ni Contact to n-type β-Ga2O3 **P.R. Sekhar Reddy,** V. Janardhanam, Hoon-Ki Lee, Kyu-Hwan Shim, Sung-Nam Lee, V. Rajagopal Reddy, Chel-Jong Choi**.** ***Journal of Electronic Materials* 49, (2020) 297-305.** 17. Temperature-Dependent Schottky Barrier Parameters of Ni/Au on n-Type (001) β-Ga2O3 Schottky Barrier Diode **P.R. Sekhar Reddy,** V. Janardhanam, Kyu-Hwan Shim, V. Rajagopal Reddy, Sung-Nam Lee and Chel-Jong Choi. “. ***Vacuum* 171 (2020), 109012.**
Sponsored Projects (Past and Ongoing)	—
Profile Links: Scopus, Orcid and Google Scholar	Orcid ID: https://orcid.org/0000-0002-2301-7636 Google Scholar: https://lnk.ink/XgpDF Home Page: https://phystfl.wixsite.com/stfl/home
Research Activities (Write about your best research results max of 2-3 pages	**Research Interest** My Research in Semiconductor materials and device characterization with the main focus on the area of functional oxide materials for more energy-efficient electronic devices and energy harvesting devices to resolve energy

including diagrams)

issues of state-of-the-art electronic devices. The potential to drive advancements in technology and contribute to various industries. It's exciting to see how your expertise in thin film depositions, characterization, and nanoscale electronic device fabrication can shape the future of electronics and materials science.

1. Organic-Inorganic Hybrid Nanocomposites based Schottky devices

Organic–inorganic hybrid nanocomposite-based Schottky devices have emerged as a promising class of functional electronics by integrating the flexibility and tunability of organic semiconductors with the electrical robustness of inorganic materials. These hybrids leverage nanoscale engineering to optimize Schottky barrier formation, charge transport, and interfacial stability. The organic phase enhances processability and optical responsiveness, while the inorganic counterpart contributes to structural integrity and charge carrier mobility. Such devices have shown great potential in photodetectors, rectifiers, and sensors. Nanocomposite fabrication methods like spin coating and printing enable scalable, low-cost production on flexible substrates. Ongoing advances in interface design and energy band alignment are key to improving performance and broadening their applicability in future electronics.

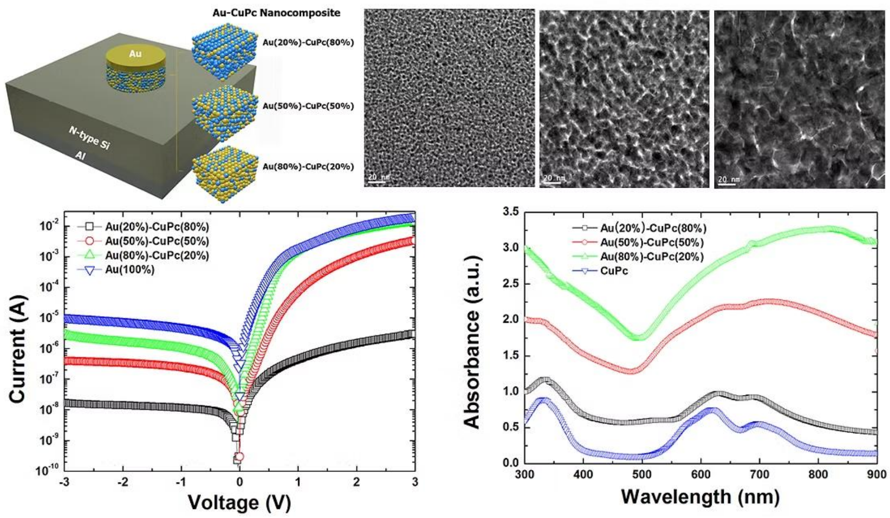
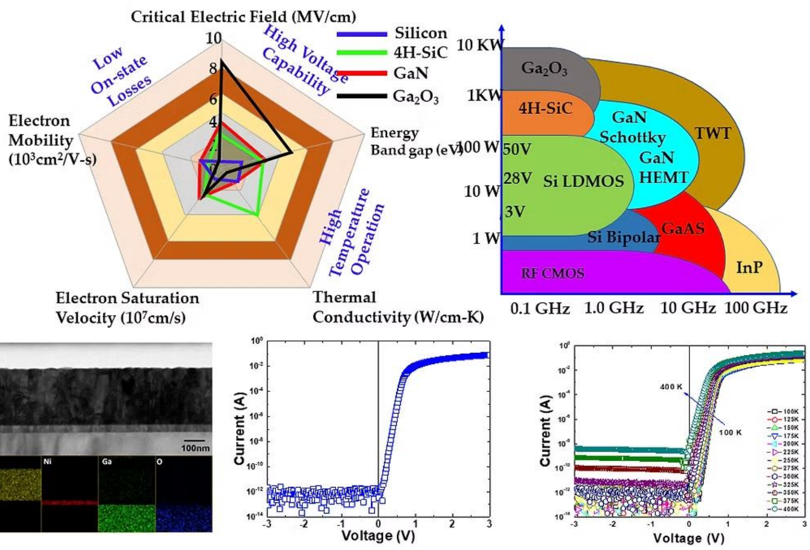


Figure shows the structural and optoelectronic characterization of the Au–CuPc organic–inorganic hybrid Schottky diode. The TEM image shows a uniform CuPc thin film with clear interfaces and polycrystalline features, confirming good film morphology. The UV–Vis absorption spectrum displays strong Q-band peaks around 610 nm and 670 nm, typical of copper phthalocyanine, indicating efficient light absorption. The schematic diagram illustrates the diode structure, where Au forms the Schottky contact with the CuPc layer, facilitating rectifying behavior. The energy band diagram highlights the formation of a Schottky barrier at the Au/CuPc interface, governing charge transport through thermionic emission. This hybrid structure demonstrates potential for low-power, flexible optoelectronic devices.

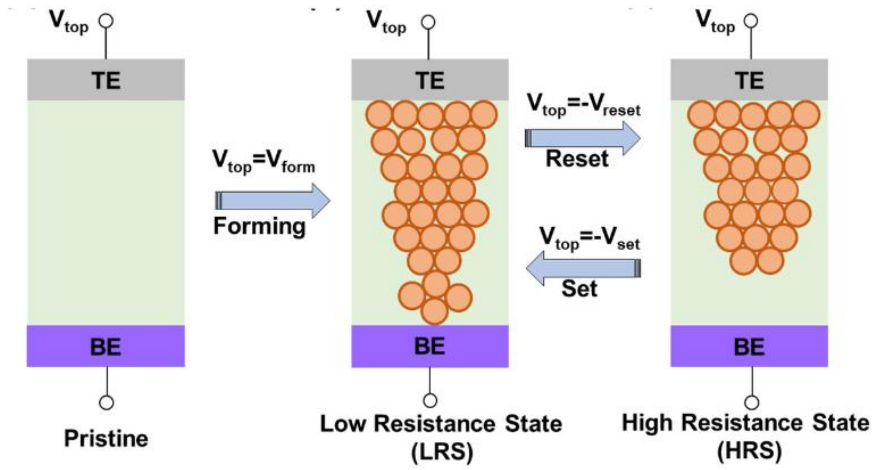
2. Gallium Oxide (β-Ga2O3) Power Devices

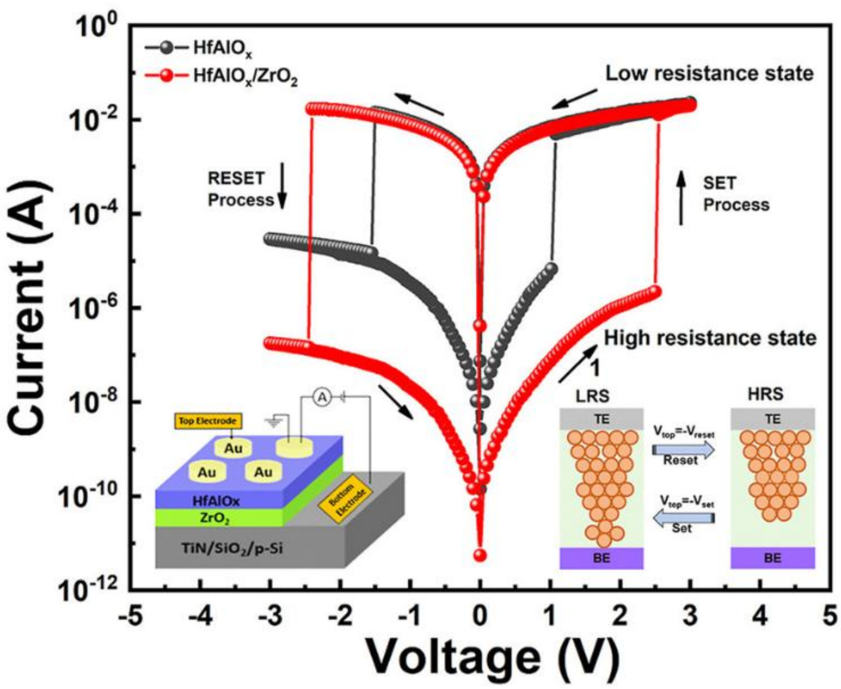
Gallium oxide (Ga_2O_3) is an emerging ultra-wide bandgap (UWBG) semiconductor with a bandgap of approximately 4.8–4.9 eV, making it highly suitable for high-power, high-voltage, and high-frequency electronic applications. Among its device configurations, the Ga_2O_3-based Schottky barrier diode (SBD) has garnered significant attention due to its potential for low leakage current, high breakdown voltage, and fast switching capabilities. The Schottky contact formed between a metal (such as Ni, Pt, or Ti) and Ga_2O_3 enables rectifying behavior, where the choice of metal critically influences the Schottky barrier height (SBH) and thus the device performance. Unlike traditional semiconductors like Si or GaN, Ga_2O_3 offers the advantage of being available in large-area native substrates through melt-growth methods, which improves crystalline quality and reduces cost. However, challenges remain in terms of thermal management and interface stability, which are crucial for long-term reliability. Despite these, Ga_2O_3 SBDs are considered promising candidates for next-generation power electronics due to their ability to operate under extreme conditions while maintaining high efficiency.



3. RRAM Non-Volatile Memory devices:

Non-volatile memory devices are storage devices that retain their data even when they are powered off. They are important in modern computing because they enable long-term storage of data that can be accessed quickly and reliably. Some examples of non-volatile memory devices include: a resistive switching memory device, also known as a "resistive memory" or "memristive device," is a type of non-volatile memory technology that relies on changes in resistance to store and retrieve data. These devices are designed to emulate certain aspects of the behavior of biological synapses, which are the connections between neurons in the brain that facilitate learning and memory



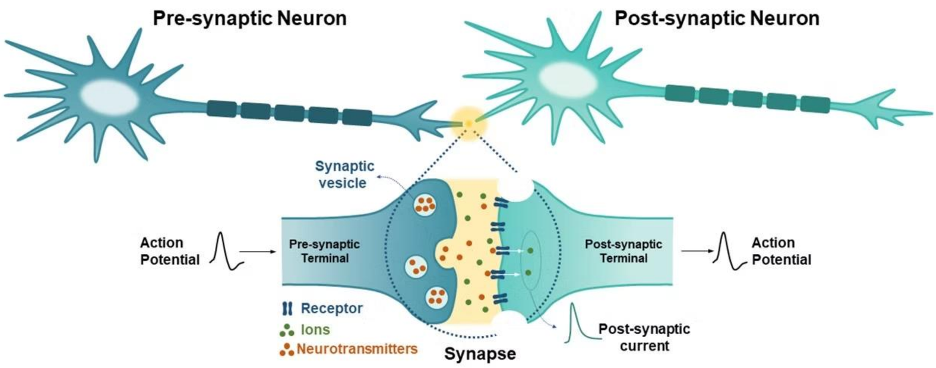


The figure illustrates the resistive switching mechanism and current–voltage (I–V) characteristics of $HfAlO_x$ and $HfAlO_x/ZrO_2$-based resistive memory devices. The top schematic demonstrates the switching process, where an initial forming voltage induces conductive filament formation, transitioning the device from a pristine state to a low resistance state (LRS). Subsequent application of a reset voltage ruptures the filament, returning the device to a high resistance state (HRS), while a set voltage reforms the filament, switching the device back to LRS. The bottom I–V plot shows the bipolar switching behavior of both devices, with the $HfAlO_x/ZrO_2$ device (red curve) exhibiting superior performance compared to the $HfAlO_x$-only device (black curve), including a larger memory window and improved separation between HRS and LRS. The enhanced switching characteristics in the bilayer structure are attributed to the optimized interface and controlled filament formation provided by the ZrO_2 layer. These results highlight the potential of $HfAlO_x/ZrO_2$-based devices for high-performance non-volatile memory applications.

4. Advancements in artificial synapses: The role of fluorite–structured ferroelectrics

4.1 Artificial Synapses

Artificial synapses are fundamental components in neuromorphic computing systems, designed to emulate the signal transmission and adaptive learning mechanisms of biological synapses. Achieving this level of functionality requires materials and devices that exhibit non-volatile, tunable, and energy-efficient electrical properties. Synapses play a major role in accomplishing the learning and adaptability of the human brain. These are specialized structures in the nerve system that allow a neuron to transmit signals chemically or electrically to another neuron or the target effector cell. Synapses are classified into two types: chemical synapses and electrical synapses.



Electrical synapses transmit a signal directly by the drift of ions without involving any chemical reactions. In this case, electrical synapses exhibit high-speed signals transmission that allows a signal to flow bidirectionally between neighboring neurons when compared to that type of chemical synapses. Fig. 1. Schematic illustration of a biological chemical synapse, which has three components: a presynaptic terminal, a synaptic cleft, and a postsynaptic terminal. By using neurotransmitters, signals are transmitted from the presynaptic terminal to the postsynaptic terminal.

4.2 Neuronal Devices

An artificial neural network (ANNs) is designed to function in the same way as the human brain. ANNs have been developed and effectively implemented in a variety of fields including image recognition, pattern recognition, voice recognition, machine translation, etc. The fundamental

<table>
<tr>
<td></td>
<td>architecture of ANNs, includes input neurons, hidden neurons, and output neurons. The information in this network only moves in the forward direction. The output layers are made up of a sequence of ANs that have been integrated to form the layer of output. The input signal is transmitted through one or more hidden layers inside the ANNs. The output layers provide outcomes at the ending of this structure. Each neuron output is subsequently sent to neurons in the next layer through synaptic connections, which multiply the signal by the appropriate synaptic weight.

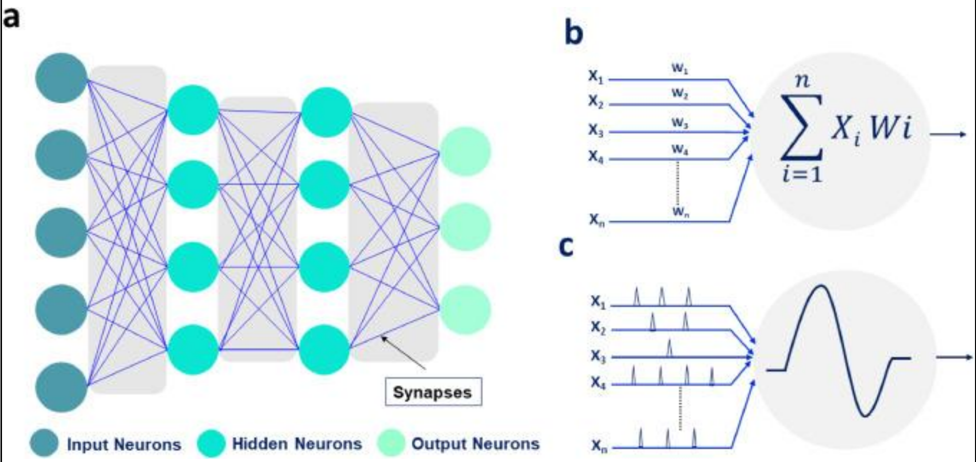


Fig. (a) Schematic drawing of artificial neural networks (ANNs) composed of input, hidden, and output neurons. Each neuron is connected by synapses to all the neurons in the next neuron layer. (b) Schematic illustration of Deep neural networks (DNNs). In DNNs, the inputs (x) from presynaptic neurons are multiplied by synaptic weights (w) and then are fed to the postsynaptic neurons. (c) synaptic neural networks (SNNs). In SNNs, a neuron receives spikes from several inputs and then fires output spikes.</td>
</tr>
<tr>
<td>Collaborations</td>
<td>Semiconductor Physics Research Center, Jeonbuk National University, South Korea, National Physical Laboratory, Sri Venkateswara University, Yogi Vemana University,</td>
</tr>
<tr>
<td>Awards and Recognition</td>
<td>Best Researcher Award: International Research Excellent Best Paper Awards, Nov.2022.
Title: “Enhanced Resistive Switching Properties of the HfAlOx/ZrO2 -based RRAM devices”. (PNS:MI 32 (2022) 602-607).

Best Paper Award : Grand Prize in Haedong, The Institute of Electronics and Information Engineering IEIE. Journal of Semiconductor Technology and Science (JSTS) Nov.2020.
Title: “Modification of Electrical Properties of Ti/p-Type InP Schottky Diode by Polyaniline (PANI) Organic Interlayer” (IEIE JSTS, 16 (2016) 664-674).</td>
</tr>
</table>