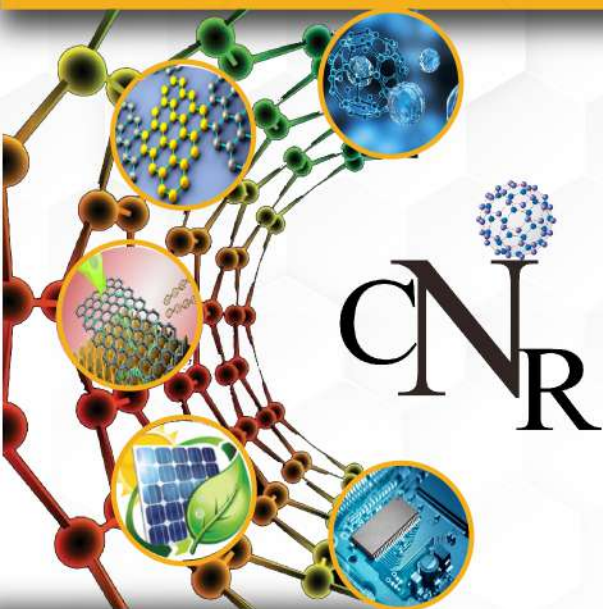




**VIT**<sup>®</sup>  
Vellore Institute of Technology  
(Deemed to be University under section 3 of UGC Act, 1956)

# CENTRE FOR NANOTECHNOLOGY RESEARCH



**CNR**

**FLEXIBLE ELECTRONIC DEVICES  
FOR ENERGY, SENSORS AND HEALTH CARE**

**BROCHURE**

## About Us

The Centre for Nanotechnology Research (CNR) at VIT, Vellore was established by the founder director Late Prof. (Dr.) J. P. Raina in June 2008 to support Academic and Research Programs in Nanotechnology. The centre is operating at the forefront of nanotechnology with a strong focus on “Flexible Electronic devices for Energy, Sensors and Health care” to provide solutions to various global issues. The centre has a unique operating model combining expertise from different branches of science and engineering to work on a common theme of Nanotechnology enabled flexible devices.

The centre has a strong relationship with the leading nanotechnology experts both from national and international level. The successful evolution of nanotechnology has centered on a unique cohesiveness to provide a nourishing atmosphere for students, researchers and the society. The core strengths of the centre are nanofabrication of flexible devices towards research areas of national priorities such as energy, sensors and healthcare. The centre is equipped with the state of the art research equipment in Nanomaterials synthesis, characterization and simulation tools. CNR undertakes consultancy on nanomaterials characterization and provides a requisite technical support to Academic Institutes and Industry.

*CNR ensures excellence in basic and applied research, provides a strong research culture and maintains gender equality. CNR also nurtures the highly cross disciplinary team members exploiting nanotechnology on the convergence of various scientific domains leading to a significant scientific breakthrough and addressing key societal challenges.*

## Mission & Vision

- ☞ To excel in advanced level of research and expanding boundaries towards flexible electronic devices.
- ☞ Serve as a catalyst for enabling interdisciplinary collaboration leading to a strong outcome in flexible devices using nanotechnology approach.
- ☞ To provide an advanced research in nanotechnology for researchers in academia and industry.
- ☞ Contributing to the improvement of quality of our life and providing technical solutions to the 21<sup>st</sup> century industries by commercializing cutting edge technology in flexible devices.



## Objectives

- ☞ Perform fundamental R&D research and advanced scientific studies in Flexible electronic devices.
- ☞ Design and fabrication of Flexible Electronic Devices towards addressing the niche and national important areas like Energy, Sensors and Health care by providing nanotechnological approaches at the atomic level that eventually lead to the manufacturing of devices.
- ☞ Educate nanotechnology through academic and research programmes towards industrial and societal benefits.
- ☞ Facilitate collaboration with leading experts nationally and Internationally to solve the scientific challenges in Nanotechnology enabled flexible electronic devices.
- ☞ Establish start-ups in Flexible devices for product development.



### Advanced Nanomaterials

Nanomaterials play a key role in building devices and structures and to cater the same, the centre has a strong focus on the fundamental and advanced approach on synthesis, characterization and applications of various dimensional nanomaterials. Various approaches like bottom-up and top down methods along with interfacial and surface engineering methods are adopted.

### Flexible devices for Energy generation and storage

Nanoscience and Nanotechnology offers a possible solution for achieving sustainable clean energy towards conversion and storage. The centre has a strong focus on energy devices like supercapacitors, solar cells and electrode materials for batteries, hydrogen production through solar water splitting and CO<sub>2</sub> photoreduction. New methods of replacing the conventional electrodes are part of this research. The research landscape spans the complete range from fundamental research to next generation technology.

### Flexible devices for sensing

A multi technology and system level approach is utilized to explore and integrate device and material functions from nano, micro to macro scale. The centre develops new enabling tools using nanotechnological approach for the fabrication of flexible sensing devices towards environmental and health care applications and explores the fundamental phenomena of the materials at the atomic level towards next generation detection technologies.

### Flexible devices for Health care

Nanotechnology is extended towards health care devices for therapeutic, sensing, and designing wearable printed devices, skin patches and bio stamping agents. The team's interest is also vested in the development of flexible electronic sensors to be deployed for detection of multiple physiological parameters of the human body.

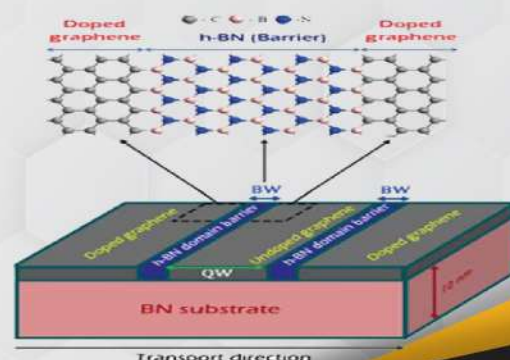
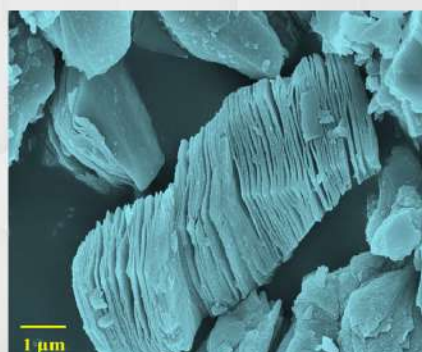
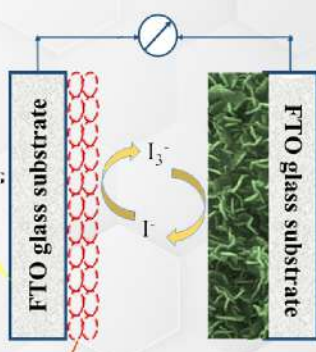
### Nanoelectronics and plasmonics

The centre has a strong research to complement the experiments through numerical computation, modeling, and simulation of materials, devices and circuits using atomic level first principle calculations to predict electronic and photonic material properties and quantum transport, semi-classical transport and (drift-diffusion) classical transport calculations to predict Nanoelectronic/Microelectronic/Photonic/Plasmonic/RF device characteristics.

### Transdisciplinary and societal research

Apart from the core research, the centre has a strong collaboration to explore the role of nanotechnology towards other industrially imperative areas of national importance like additive manufacturing, agriculture and coating technology.

The centre extends technology-driven research for societal and environmental issues by providing solutions in water treatment, agriculture and waste management.



## Infrastructure & Facilities

The centre has established state of the art research facilities in par with the international standards with the support of VIT management and the Government of India through funded projects. The centre has sophisticated synthesis, characterization and advanced computation and simulation facilities.

The synthesis and characterization lab has 650 sq.ft Class 1000 clean room equipped with class 100 housing the major equipment for material and device testing as well as microscopical tools for atomic level characterization. Thin film deposition units towards fabrication of various devices are established at the centre.



The centre has sophisticated computer simulation capabilities ranging from atomic level first principle calculations towards Nanoelectronic/Microelectronic/Photonic/Plasmonic/RF applications. It is equipped with 4 advanced HP high performance cluster computing servers, 2 high end HP work stations and 33 HP multi core Desktop systems with softwares like Synopsis Quantum Atomistic Tool kit (ATK), Silvaco TCAD Tool suit-Athena Process & Atlas Device Simulators, COMSOL Multiphysics and MATLAB.

The centre has developed a unique protocol to integrate these skills to develop and offer interdisciplinary research projects.

### Sophisticated Tools

Raman spectrophotometer, Solar simulator, Advanced electrochemical test station, Particle Size & Zeta Potential Analyzer, Keithley semiconductor parameter analyzer, Probe station, Physical vapour deposition, Chemical vapour deposition, Magnetron sputtering unit, Spray pyrolysis, Screen printer, 3D printer, High temperature hot press, Photoelectrochemical set up, Thermogravimetric analyzer, Differential scanning calorimetry, Atomic force microscope, Scanning Tunnelling Microscope, Optical microscope.

## Research minds

Faculties at CNR are diverse in disciplines hinting at the interdisciplinary nature of the research centre, which provokes to think beyond nanotechnology and to provide solutions to the pressing research problems. The centre is also reinforced with researchers working on our focussed areas to provide solutions to many challenges in the development of flexible electronic devices. Faculty members and their research teams conduct work towards the centre's focus while postdocs, collaborators and visiting professors enrich our research visions through their inputs and collaborations. Regular programmes are conducted like guest lectures, workshops and International conferences to bring together Indian and International communities and stakeholders from academia, government laboratories, industry and other organisations working in the field of nanoscale science and technology to discuss new and exciting advances in the field. The centre organized international conferences in the niche areas of nanotechnology, ICNAN-2016 (<https://vit.ac.in/files/icnan2016/index.php>), ICNAN-2019 (<https://vit.ac.in/ICNAN/>) and VCAN-2020 (<https://vit.ac.in/VCAN2020/>), which had two Nobel Laureate lectures during the event.

## Funded Projects

The centre has received many funded projects from the Government of India on the thematic areas.

| PI                    | Project Title  | Funding Agency              | Amount sanctioned (INR in lakhs) |
|-----------------------|--|-----------------------------|----------------------------------|
| Dr. A. Nirmala Grace  | Synthesis, Development and Investigation of Vanadium nitride (VN), Titanium nitride (TiN) based Nanomaterials as low cost counter electrodes for Dye Sensitized Solar Cells (DSSC) | DST/SERB (2017-2019)        | 46.43                            |
| Dr. A. Nirmala Grace  | Design and Development of a hybrid mechanochemical bioreactor for recovery of precious metals and recycling of electronic waste.   | DST/TSG (2016-2019)         | 72.36                            |
| Dr. Raja Sellappan    | Unassisted solar water splitting using nanostructured n-BiVO <sub>4</sub> and p-Cu <sub>2</sub> O tandem cell for hydrogen production  | DST/SERB (2018-2020)        | 26.35                            |
| Dr. Niroj Kumar Sahu  | Development of Anisotropic Magnetic Nanostructured Material for Hyperthermia.  | DST/SERB (2015-17)          | 42.18                            |
| Dr. Krishnamoorthi C  | Development of biocompatible magnetic spin relaxation hyperthermia materials by coupling in core-shell nanostructures modifying magnetic parameters through magnetic exchange      | DST/SERB (2018-2020)        | 20.67                            |
| Dr. Penchalaiah Palla | Designing GNM/hBN- quantum dot based hybrid photo detectors  | DRDO (2018-2020)            | 12.74                            |
| Dr. A. Nirmala Grace  | Development of Engine Nanocoolants for Armoured Fighting Vehicle   | DRDO, CVRDE (2012-2017)     | 23.48                            |
| Dr. A. Nirmala Grace  | Development of carbon nanomaterials for the removal of heavy metal ions towards water purification applications.   | DST-WTI (2012-2014)         | 12.72                            |
| Dr. V. Velmurugan     | Safe drinking water through silver clay filters  | IEEE-USA (2011-2016)        | 5.10                             |
| Dr. Gargi Raina       | PG Program - Phase I   | DST/Nanomission (2008-2014) | 294                              |
| Dr. Gargi Raina       | PG Program - Phase II  | DST/Nanomission (2015-2021) | 462.6                            |

**Total 10.19 Crores**

Centre contributes to the scientific world through significant publications as Books, Research articles with reputed publishers. CNR has a strong output in terms of peer reviewed high impact publications in niche areas and is steadily growing with years.

|   |   |
|---|---|
| <p><b>Journal of Materials Chemistry A</b></p> <p><b>PAPER</b></p> <p><b>Fabrication of CeO<sub>2</sub>/Fe<sub>2</sub>O<sub>3</sub> composite nanospindles for enhanced visible light driven photocatalysts and supercapacitor electrodes</b></p> <p>N. Sabari Arul,<sup>a,b</sup> D. Mangalaraj,<sup>a,b</sup> R. Ramachandran,<sup>c</sup> A. Nirmala Grace<sup>c</sup> and Jeong In Han<sup>d</sup></p> <p><b>IF: 11.30</b></p> <p>Applied Energy</p>  | <p><b>Chemical Engineering Journal</b></p> <p><b>Magnetic SiO<sub>2</sub>@CoFe<sub>2</sub>O<sub>4</sub> nanoparticles decorated on graphene oxide as efficient adsorbents for the removal of anionic pollutants from water</b></p> <p>Chella Santhosh<sup>a,c</sup>, Ehsan Daneshvar<sup>a</sup>, Pratap Kollu<sup>b,c</sup>, Sirpa Peräntemi<sup>d</sup>, Andrews Nirmala Grace<sup>c</sup>, Amit Bhatnagar<sup>a,c</sup></p> <p><b>IF: 10.65</b></p> <p>Chemistry of Materials</p>              |
| <p><b>Applied Materials Today</b></p> <p><b>Effect of reducing agent on graphene synthesis and its influence on charge storage towards supercapacitor applications</b></p> <p>Rajendran Ramachandran<sup>a</sup>, Murugan Saranya<sup>a</sup>, Venugopal Velmurugan<sup>a</sup>, Bala P.C. Raghupathy<sup>b,c</sup>, Soon Kwan Jeong<sup>a,c</sup>, Andrews Nirmala Grace<sup>a,c,d</sup></p> <p><b>IF: 8.84</b></p> <p>Applied Materials Today</p>   | <p><b>ChemSusChem</b></p> <p><b>Checking in with Women Materials Scientists During a Global Pandemic: May 2020</b></p> <p><b>IF: 9.56</b></p> <p>ChemSusChem Communications</p>   |
| <p><b>Journal of Colloid and Interface Science</b></p> <p><b>MXenes—A new class of 2D layered materials: Synthesis, properties, applications as supercapacitor electrode and beyond</b></p> <p>Sandhya Venkateshulu, Andrews Nirmala Grace<sup>a</sup></p> <p><b>IF: 8.35</b></p> <p>Journal of Colloid and Interface Science</p>   | <p><b>Electrochimica Acta</b></p> <p><b>Carbon Dioxide Sequestration by Using a Model Carbonic Anhydrase Complex in Tertiary Amine Medium</b></p> <p>Dharmalingam Sivanesan<sup>a</sup>, Youngju Choi<sup>b</sup>, Jiyeon Lee<sup>b</sup>, Min Hye Youn<sup>b</sup>, Ki Tae Park<sup>b</sup>, Andrew Nirmala Grace<sup>c</sup>, Hak-Joo Kim<sup>b</sup> and Soon Kwan Jeong<sup>a</sup></p> <p><b>IF: 7.35</b></p> <p>Electrochimica Acta</p>   |
| <p><b>Electrochimica Acta</b></p> <p><b>Reversible, stable Li-ion storage in 2 D single crystal orthorhombic α-MoO<sub>3</sub> anodes</b></p> <p>Ravuri Syamsai<sup>a</sup>, Jassiel R. Rodriguez<sup>b</sup>, Vilas G. Pol<sup>b</sup>, Andrews Nirmala Grace<sup>a,c</sup></p> <p><b>IF: 6.49</b></p> <p>Electrochimica Acta</p>  | <p><b>SCIENTIFIC REPORTS</b></p> <p><b>Pt-free, low-cost and efficient counter electrode with carbon wrapped VO<sub>2</sub>(M) nanofiber for dye-sensitized solar cells</b></p> <p>Subashini Gramascker<sup>a</sup>, Pratap Kollu<sup>a,c</sup>, Soon Kwan Jeong<sup>a</sup> &amp; Andrews Nirmala Grace<sup>a</sup></p> <p><b>IF: 3.99</b></p> <p>Scientific Reports</p>   |
| <p><b>International Journal of Biological Macromolecules</b></p> <p><b>Heteroatom doped graphene based hybrid electrode materials for supercapacitor applications</b></p> <p>Ravichandran Santhosh<sup>a</sup>, S.R. Sitaa Raman<sup>a</sup>, Sudha Murali Krishna<sup>b</sup>, Syam Sai Ravuri<sup>a</sup>, V. Sandhya<sup>a</sup>, Sourav Ghosh<sup>b</sup>, Niroj Kumar Sahu<sup>b</sup>, Sathyanarayanan Punniyakoti<sup>a</sup>, Mani Karthik<sup>b</sup>, Pratap Kollu<sup>a,c</sup>, Soon Kwan Jeong<sup>a</sup>, Andrews Nirmala Grace<sup>a,c</sup></p> <p><b>IF: 5.34</b></p> <p>International Journal of Biological Macromolecules</p> | <p><b>Journal of Alloys and Compounds</b></p> <p><b>Polyol mediated synthesis of anisotropic ZnO nanomaterials and composite with rGO: Application towards hybrid supercapacitor</b></p> <p>Sudha Murali<sup>a</sup>, Pradeep Kumar Dammala<sup>a</sup>, Barkha Rani<sup>a</sup>, Ravichandran Santhosh<sup>a</sup>, Charushila Jadhao<sup>a</sup>, Niroj Kumar Sahu<sup>b</sup></p> <p><b>IF: 4.35</b></p> <p>Journal of Alloys and Compounds</p>  |
| <p><b>Journal of Photochemistry &amp; Photobiology, B: Biology</b></p> <p><b>Natural and synthetic polymer for graphene oxide mediated anticancer drug delivery—A comparative study</b></p> <p>Ananya Deb<sup>a</sup>, Vimala R<sup>b</sup></p> <p><b>IF: 5.16</b></p> <p>Journal of Photochemistry &amp; Photobiology, B: Biology</p>  | <p><b>Journal of Electrochemical Energy Conversion and Storage</b></p> <p><b>Effect of Plasma Fluorination in p-Type SnO TFTs: Experiments, Modeling, and Simulation</b></p> <p>Kadiyam Rajshakar<sup>a</sup>, Hsiao-Hsuan Hsu<sup>a</sup>, Kogolu Uma Mahendra Kumar<sup>a</sup>, P. Sathyanarayanan<sup>a</sup>, V. Velmurugan<sup>a</sup>, Chun-Hu Cheng<sup>b</sup>, and D. Kannadasan<sup>a</sup></p> <p><b>IF: 2.97</b></p> <p>Journal of Electrochemical Energy Conversion and Storage</p> |
| <p><b>Journal of Materials Chemistry A</b></p> <p><b>Magnetic and photocatalytic studies on Zn<sub>1-x</sub>Mg<sub>x</sub>Fe<sub>2</sub>O<sub>4</sub> nanocolloids synthesized by solvothermal reflux method</b></p> <p>A. Manohar<sup>a</sup>, C. Krishnamoorthi<sup>a</sup></p> <p><b>IF: 4.01</b></p> <p>Journal of Materials Chemistry A</p>  | <p><b>Journal of Materials Chemistry A</b></p> <p><b>Magnetic and photocatalytic studies on Zn<sub>1-x</sub>Mg<sub>x</sub>Fe<sub>2</sub>O<sub>4</sub> nanocolloids synthesized by solvothermal reflux method</b></p> <p>A. Manohar<sup>a</sup>, C. Krishnamoorthi<sup>a</sup></p> <p><b>IF: 4.01</b></p> <p>Journal of Materials Chemistry A</p>  |

## Collaborations

### A rich collaboration of world class minds

CNR has an extensive collaboration with many research groups across the globe to transform research outcomes into integrated commercializable technologies.



## Opportunities

The centre is always interested in talented people who want to contribute to the field of nanotechnology towards flexible devices. CNR welcomes motivated researchers to join the group and explore the world of small. Visit <https://vit.ac.in/centers/cnr> for frequent updates on opportunities.

## Services

CNR offers access to a wide range of scientific equipment towards testing and characterization at the nanoscale. In order to use the equipment, please contact us (<https://vit.ac.in/center/info/cnr/Service>)

The centre is poised to new visions in Nanoscience and Nanotechnology research in the years to come providing complete scientific support through our established facilities, training, access to our facilities and scientific guidance.

The Centre for Nanotechnology research welcomes and encourages the

- ☞ Users utilize the facilities on fabrication and characterization
- ☞ Students to seek an exciting career in Nanotechnology
- ☞ R&D and Academic collaborators

## Credentials of VIT - Accreditations / Rankings / Ratings

Govt. of India has recognized VIT, Vellore as an  
**Institution of Eminence (IoE)**



Ranked in the Top 9 institution in India - 2020



**NIRF (National Institutional Ranking Frame work)**

No. 15 in Engineering Institution - 2020

No. 16 in University Category - 2020

No. 55 in Management Institution - 2020

No 28 in Overall - 2020



**NAAC (National Assessment and Accreditation Council)**

Accredited in 2015 - A grade

Accredited in 2009 - A grade

Completed 3 Cycles of Accreditation



**ABET (Accreditation Board for Engineering and Technology), USA**

3 Times Accredited

10 B.Tech Programs – Vellore Campus

4 B.Tech Programs – Chennai Campus



**IET (The Institution of Engineering and Technology), UK**

Accredited in 2005



**NBA (National Board of Accreditation)**

Accredited in 2009

Accredited in 1998



**FICCI (Federation of Indian Chambers of Commerce & Industry)**

"Excellence in Enabling Research Environment" - 2019

"Excellence in Internationalization of Edu." - 2018

"Excellence in Faculty" - 2017

"University of the Year" - 2016



**UGC graded autonomy in 2018**

Government endorsed recognition for VIT



**No.1 Position - 2019**  
(Private Institutions)



**QS RATING 2016**

4 STAR overall Rating in 2016

Got 5 STAR Rating for 5 Sub Categories

(Teaching, Employability, Facilities, Innovation and Inclusiveness)

First University in India to get QS 4 Star Rating



**THE WORLD and ASIA UNIVERSITY RANKINGS**

Ranked in the Top 801-1000 in 2020 (World Ranking)

Ranked in the Top 201-250 in 2018 (Asia Ranking)

Ranked 28 in 2020 (India Ranking)



**QS UNIVERSITY RANKING 2020**

Ranked in the Top 801 - 1000 (World)

Ranked 228 (Asia)

Ranked 28 (India)



**India Research Excellence – Citation Awards 2019**



**QS I.GAUGE**

Got DIAMOND University Rating in 2018



**ACBSP (The Accreditation Council for Business Schools and Programs), USA**

VITBS is fully Accredited for 10 years from 2017



**ACCA (Association of Chartered Certified Accountants, UK)**

BBA Programme is Accredited from 2017

The Next Big thing is really small – Welcome to the Centre for Nanotechnology Research

### Contact Us

Prof. (Dr.) A. Nirmala Grace  
Professor & Director  
Centre for Nanotechnology Research  
VIT, Vellore - 632014, Tamil Nadu, India

mail: [director.cnr@vit.ac.in](mailto:director.cnr@vit.ac.in)

Phone (O) : +91416-2202462; Secretary (O): +91416-2202461

Mobile: +91 9791322311

Fax: +91416-2243092; 2240411

[www.vit.ac.in/centers/cnr](http://www.vit.ac.in/centers/cnr)