Prof. (Dr.) Nandakumar Kalarikkal

Senior Professor (*Former Director & Chair*)

School of Pure and Applied Physics

&

Hon: Director

University Centre for Ultrafast Studies

&

Adjunct Professor (*Former Director & Joint Director*)

International and Inter University

Centre for Nanoscience and Nanotechnology

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www.spap.mgu.ac.inhttp://nandakumarkalarikkal.com/

Google Scholar Citations:

https://scholar.google.com/citations?user=vgr6uKIAAAAJ&hl=en

Books: **https://www.amazon.in/Books-Nandakumar-Kalarikkal/s?rh=n%3A976389031%2Cp_27%3ANandakumar+Kalarikkal**

AD Scientific Index: **https://www.adscientificindex.com/scientist/nandakumar-kalarikkal/393550**

Personal Data

Date of birth: 30th May 1964

Nationality: Indian

Education

M. Sc. (*Master of Science*), **Physics (*Specialization in Industrial Physics*) (1986)**
Cochin University of Science & Technology, Kerala, India
Ph. D. (*Doctor of Philosophy*), **Semiconductor Physics (1987-1992)**
Cochin University of Science & Technology, Kerala, India
Thesis title: ***"Optical and thermal properties of selected ternary amorphous semiconductors".***
Postdoctoral Fellow (1993-1994)
CSIR-National Institute for Interdisciplinary Science and Technology, Thiruvananthapuram,

Kerala, India

Career Details

Post held	Organization/ University	Duration		Experience (in Years & Months)
		From (Date)	To (Date)	
Senior Professor	**School of Pure and Applied Physics**	**27th July 2019**	**Till date**	**4 years & 3 months**
Hon: Director	**Centre for Ultrafast Studies**	**9th August 2023**	**Till date**	
Dean	**Faculty of Technology & Applied Sciences**	**7th May 2023**	**Till date**	
Director-in-Charge	**School of Nanoscience and Nanotechnology**	**August 2019**	**31st January 2022**	**2 years & 4 months**
Director	**International and Inter University Centre for Nanoscience and Nanotechnology**	**11th October 2017**	**6th November 2022**	**5 years**
Director & Chair	**School of Pure and Applied Physics**	**17th October 2018**	**16th October 2021**	**3 years**
Director	**International and Inter University Centre for Nanoscience and Nanotechnology**	**11th September 2015**	**1st February 2016**	**6 months**
Joint Director	**International and Inter University Centre for Nanoscience and Nanotechnology**	**28th March 2009**	**10th September 2015**	**6 years & 6 months**
Professor	**School of Pure and Applied Physics**	**27th July 2009**	**26th July 2019**	**10 years**
Associate Professor	**School of Pure and Applied Physics**	**27th July 2006**	**26th July 2009**	**3 years**

Reader **Sr. Lecturer** **Lecturer**	**School of Pure and Applied Physics**	**27th July 2003** **27th July 1998** **18th May 1994**	**26th July 2006** **26th July 2003** **26th July 1998**	**12 years**

Total Number of publications: 260+

Projects Ongoing: 09 (As PI), 07 (As Co-PI)
(As PI: 3-National, 2-International, 4-SPARC)
(As Co-PI: 4-National, 3-International)

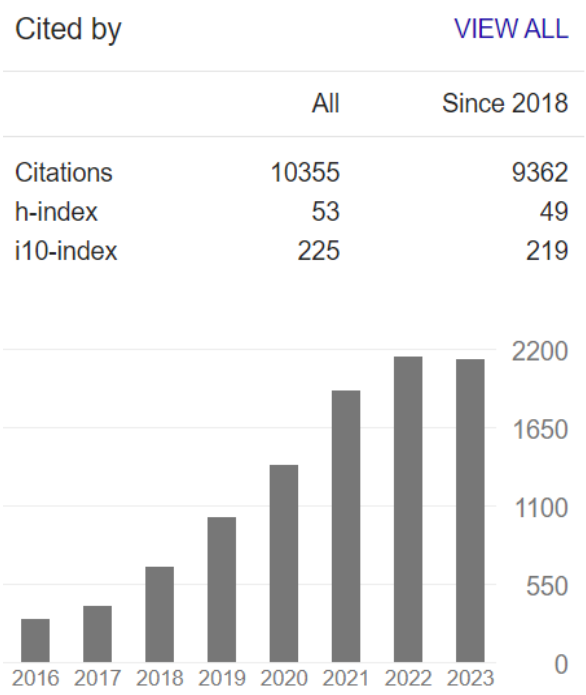
Projects completed: 08

Number of Books Chapters: 16

Number of Books edited: 32

Number of Ph. Ds Supervised: 19
Number of Ph. Ds Co-supervised: 09
Number of current Ph. D students: 08
Number of M. Phil and M.Sc. theses Supervised: 25

Google scholar profile
Books



Recognition

- Visiting Professor, Lanzhou University, P R China 2023
- Fulbright Fellow 2022
- Professor@Lorraine, University of Lorraine, Nancy, France for three years from 2020-2023
- CNRS Professor, Claud-Bernard University Lyon, Lyon, France
- Visiting Professor, Institute of Jean Lamour, Nancy, France
- Visiting Professor, Stockholm University, Sweden
- Guest Scientist, Leibniz-Institut fur Polymerforschung Dresden, Germany
- Visiting Fellow, Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore, India
- Visiting Fellow, Gulbarga University, Gulbarga, Karnataka under SAP scheme of UGC
- Visiting Faculty, Alemaya University (1998-2002) & Mekkele University (2006-2007), Ethiopia (on leave from Mahatma Gandhi University)
- Keynote Speaker in the WasteEng2018 conference held at Prague, Czech Republic held during 1-6 July2019
- Keynote speaker in the International Conference on Polymer Processing and

Characterization-ICPPC 2017 held at Gdansk University of Technology, Gdansk, Poland during 27-29 September 2017

- Invited speaker in the DAE SSPS 2018 held at Bhabha Atomic Research Centre, Mumbai in December 2017
- Invited speaker for the Silver Jubilee Research Conference on ‚Study of matter using intense radiation sources and under extreme conditions` organized by UGC-DAE CSR-Indore, India during 3-6 November2016
- Conference Fellowship Award of the Seventh International Conference on Phonon Scattering in Condensed Matter held at Cornell University, USA (1992)
- Research Associate Fellowship from DST & CSIR, Govt. of India (1992)
- Senior Research Fellowship from CSIR, Govt. of India (1990)
- Junior Research Fellowship from Department of Atomic Energy, Govt. of India (1987)

Teaching areas

- Materials Science/Solid State Physics, Quantum Optics, Statistical Physics, Quantum Mechanics, Classical Mechanics, Physics of Nanomaterials, Mesoscopic Physics, Introduction to Nanoscience and Nanotechnology (Open Course), Experimental Physics, Nanophotonics

Research Areas

The research works of my group include the syntheses, characterization and applications of various Nanomaterials, LASER Plasma, Ion irradiation effects on various novel materials and phase transitions. The different topics of current research works are:

- **2D Materails and their hybrids**

Different types of 2D materials (rGO, MoS_2, WS_2) and their hybrids have been synthesized using various methods and explored their applications in fields such as batteries, fuel cells, water splitting, sensors etc.

- **Laser Matter Interactions and Applications**

Laser-matter interactions involving ultrafast processes in nanostsructured materials, laser ablation in liquid media to probe the cavitation and bubbling process, Laser Induced Breakdown Spectroscopy (LIBS) to correlate the plasma parameters with nanoparticle generation and hybrid structure fabrication and Pulsed Laser Deposition (PLD) for the preparation of thin films and correlate the structure with plasma parameters.

- **Nanomultiferroics**

In this class of materials, we are synthesizing various systems such as R-CrO_3, R-MnO_3 and R-Fe_2O_4 where R could be Ho, Er, Tm, Yb, Lu or Y. The samples are prepared mainly through sol-gel route and characterized for their structural, multiferroic, linear and nonlinear optical properties using XRD, TGA/DTA, SEM, HRTEM, FTIR spectroscopy, Dielectric spectroscopy, VSM, UV-Vis-NIR spectroscopy, Photoluminescence spectroscopy and Z-scan technique. The thermal parameters such as heat capacity, thermal conductivity and thermal diffusivity are also investigated near the multiferroic transitions. The synthesis and multiferroic coupling of engineered composite nano/multiferroics are also a thrust area of the group.

- **Molecular Magnetism**

The area of molecular magnetism is rapidly growing towards the use of magnetic molecules and molecule-based magnetic materials in technology-driven fields, in particular molecular spintronics, quantum technologies, metal–organic frameworks (MOFs) and 2D materials. The activities in this field are to design novel molecular structures tailored towards potential applications.

- **Quantum dots and Nanophosphors**

In this class of materials, we concentrate on various types of quantum dots, metal and metal oxide nanomaterials. The materials are prepared through novel green synthesis routes and sol-gel method and characterized for their various properties. The potential uses of these materials are being explored in different fields which include water purification, sensing and lighting applications.

- **Nanocomposites**

Under this class of materials various metal, metal oxide, carbon structures (grapheme and CNT), magnetic particles and quantum dot filled polymer nanocomposite materials are prepared using various chemical routes. The interfacial effects and applications of the as prepared nanocomposites are also a thrust area for the group.

- **Polymer nanocmposites**

Various polymer nanocomposites are developed by the group for water purification, nanoenergy generation, EMI shielding, edible coatings, tissue regeneration and wound healing applications

- **Nanoferroelectrics**

Under this class, we are mainly concentrating on relaxor type of ferroelectrics such as Strontium Barium Niobate systems and the effect of rare earth ion doping on the linear and nonlinear optical properties. The samples are being characterized for various properties using sophisticated techniques. The phase transitions in this class of materials are also investigated in detail. Electroactive polymer nanocomposites of these materailsfor tailored applications also explored.

- **Nanoferrites**

Different nanostructured spinel ferrite systems have been prepared using sol-gel technique and their structural, magnetic, electrical, linear and nonlinear optical properties are investigated. Various systems such as $NiFe_2O_4$, $CoFe_2O_4$, $ZnFe_2O_4$ and mixed compositions of these ferrites have been synthesized and their various physical properties are investigated. The water soluble nanoferrites are also of potential interest to the group.

- **Nanomedicine**

Under this area, we are mainly concentrating on the preparation and characterization of Polymer based scaffolds for biomedical applications. New hybrid polymer nanocomposites for dental applications are also a thrust of our group.

- **Nanosensors**

The various nanomaterials synthesized in the laboratory are explored for different sensing applications which include nanoparticles incorporated membranes for bio-sensing and water purification applications.

- **Ion beam irradiation effects & Phase transitions**

Heavy ion beam irradiation effects on the structural and multiferroic properties of sol- gel

derived films of selected nanomultiferroic films are investigated under this category. The studies on the phase transitions of bulk and nanomaterials are also investigated using different techniques.

- **Climate Change**

Aerosol samples collected from urban and semi urban areas of Indian subcontinent are analyzed for chemical characteristics and effects on climatic conditions and atmospheric pollution. Single particle analysis of airborne samples from different altitudes of *Indo Gangetic Planes* and eastern metropolitan areas for source approximation and climate modeling, and cloud seeding are of current interest.

- **Water**

Development of hybrid materials for water purification, Photocatalysts for degradation of pesticides and herbicides, Biosensors for detection of pathogens and antibiotics in water bodies are major research.

- **Computational Modeling and Simulation**

Employing the first principle Density Functional Theory (DFT) to understand many novel hybrid nanostructures using the popular codes such as VASP and Gaussian and thereby predict specific properties towards certain applications.

- **Water and Waste Management Policy Development**

Various strategies and formulation of the management of different wastes such as plastics, electronic, biomass, pharmaceutical etc. and the development of policy strategies to implement sustainable effective waste management along with a comparative analysis between developed, developing and under developed countries.

Facilities available

A very good wet chemistry synthesis laboratory with major infrastructure facilities such as Furnaces, Centrifuge, Magnetic stirrers, pH meters, Hot air ovens, Microwave oven, Pelletizer, Ultrsonicator and Spin Coaters, Nanobiology lab with facility for antibacterial and cell culture studies, Nd:YAG LASER (1 Joule), Femtosecond Laser (To be installed soon), Spectrograph, ICCD and CCD cameras, He-Ne LASER and Quadrant Detector.

For experimental characterizations, Dielectric and resistivity measurement facilities from 77K to 773K, UV-Vis-NIR spectrophotometer, Spectrophotoflourimeter with life time measurement facility, X-ray diffractometer with SAXS, ME coupling measurement unit, AFM, HRTEM, NETWORK Analyzer, Gas permeability measurement set up, Electrospinning Unit, Vibrating Sample Magnetometer are available.

SEM, FESEM, Confocal Raman with AFM, GCMS etc. are available as Central facilities of the University

Research Grants

National-Ongoing

Recent Projects sanctioned under the RUSA scheme Govt. of India (2023)

- Novel 2D Materials Hybrids for (a) Water Splitting (b) Water Purification and (c) Pesticide/Herbicide Detection in water bodies-(**Principal Investigator**)

- Development of paper-based SERS platforms for pathogens/bacteria screening and their detection in water bodies-(**Principal Investigator**)
- Fabrication of three-dimensional nanocellulose-based multifunctional materials for tissue engineering and regenerative medicine applications-(**Principal Investigator**)

Other Ongoing Projects

- Design and Development of Highly sensitive Glucose Sensor Based on 2D Transition Metal Dichalcogenides (TMDCs): Theoretical Modelling and experimental Verification-Science & Engineering Research Board (SERB)-Govt. of India under the Core Research Grant Scheme-(**Principal Investigator**)
- Physics of Cavitation Bubbles and Hydrogen Generation during Liquid Phase Laser Ablation-BRNS/BRFST-DAE-Govt. of India-(**Principal Investigator**)
- Design and applications of magnetically responsive self-assembled polymer nanocomposites, DST-Nano Mission-Govt. of India-(**Principal Investigator**)
- Heavy Ion/Gamma ray Engineered Vertically Oriented Graphene Hybrid systems for Environmental Remediation, UGC-DAE-CSR Kolkata Centre Project (**Principal Investigator**)
- Graphene-Silica conjugated epoxy nanocomposites for protective coating and repair applications, DRDO, Ministry of Defense-Govt. of India-(**Principal Co-Investigator**)-Rs.
- Visvesvaraya PhD Scheme for Electronics and IT, MeitY, Ministry of Communications and Information Technology, Government of India-(**Principal Co-Investigator**)
- Gamma Ray/Heavy Ion Assisted Cross-linked Silicone Rubber Based EMI Shielding Materials, UGC-DAE-CSR Kolkata Centre Project-(**Principal Co-Investigator**)
- Design and implementation of small scale environmental energy harvesters by piezoelectric/ multiferroic polymer nanocomposites**,** Scheme for Transformational and Advanced Research in Sciences (STARS), Ministry of Human Resource Development (MHRD), Govt. of India-(**Principal Co-Investigator**)

- **SPARC Funded by MHRD-Govt. of India Projects-Ongoing-(Principal Investigator)**

Project Title	**Collaborating University**
Bio-filler-Interfaced Electrospun PVDF Hybrid Piezoelectric Generator for Mechanical Energy Harvesting	UNIVERSITÉ DE MONTPELLIER & University of Lorraine, France
Study of urea oxidation electrocatalysis for energy conversion from waste	Ben Gurion University of the Negev & Ariel university, Israel
Vachellianilotica based biocompatible hybrid nanostructured coatings/films for seeds and fruits	North Carolina State University & Kansas State University, USA
Nanoscale contrast agents for diagnostic biomedical imaging	Nanyang Technological University (NTU) , Singapore

International-Ongoing & Completed

1. **"Engineering of novel hybrid nanostructures for perovskite solar cell application"** under the BRICS Scheme jointly with Lanzhou University, PR China, Johannesburg University, South Africa and LMCP - LIMC - IMA - Centro de Tecnologia II & Universidade Federal do Rio de Janeiro, Brazil- **Indian Principal investigator**
2. **"Multiferroic Perovskite-Based Nanostructures for EMI Shielding and Photovoltaic Applications", India-Sebia project** with Dr. Dejan M Djokic, Institute of Physics, Belgrade,Serbia (2022)-**Indian Principal investigator**
3. **"Advanced polymer nanocomposites for micro-actuator and energy harvesting devices"** with Prof. Didier Rouxel, Institute of Jean Lamour and University of Lorraine, France under the International Research Project (IRP)-CNRS Scheme, France (2022)-**Indian Principal investigator**
4. '**Analysis and networking about topics of future research on sustainable materials for decentralized water purification in rural India**' supported by FORMAS, Sweden jointly with Prof. Niklas Hedin, Professor, Department of Materials and Environmental Chemistry MMK, Stockholm University, Sweden. FORMAS is a Swedish Research Council for Sustainable Development (2021-24) –**Indian Partner**
5. **"Green Synthesized Noble Metal-Nanoclusters Modified Nanostructures: From fundamental studies to their applications in energy conversion"** sanctioned under the International Emerging Actions-CNRS Scheme, France (2022)-jointly with Prof. Rodolphe Antoine , Institite of Light Matter (ILM), Cluade Bernard University Lyon, Lyon, France-**Indian Principal Co-Investigator**
6. **"Bio-Filler-Interfaced Electrospun PVDF-Nanomultiferroic Hybrid Piezoelectric Generator for Mechanical Energy Harvesting"** jointly with Prof. Didier Rouxel, Institute of Jean Lamour & University of Lorraine, France under the CEFIPRA Scheme-**Indian Principal Investigator**
7. **Fabrication of three-dimensional nanocellulose-based multifunctional materials for tissue engineering and regenerative medicine applications**-Under the **BRICS scheme** with **Russia, China and India**-**Indian Principal Co-Investigator**
8. Biobased Scaffolds, Membranes and Hydrogels for Improved Wound Healing andBone Regeneration (BIOHEAL)-Swedish Research Link Grant in collaboration with Prof. Aji Mathew, *University of Stockholm, Sweden*-**Indian Co-PI (Completed)**
9. Advanced Nanocomposites for Micro and Nanosensors Applications-under the PICS scheme with Prof. Didier ROUXEL, *Institut Jean Lamour* - UMR CNRS n°7198 - *Université de Lorraine*- BP 70239 - 54506 Vandœuvre-lès-Nancy Cedex –*France*-**Indian Co-PI (Completed)**

Projects completed:

1. Irradiation effects on the structural and electrical properties of selected ferroelectric ceramics, NSC-UFUP project-IAC-Govt. of India-(**Principal Investigator**)
2. Ion beam irradiation effects on the structural and ferroic properties of selected sol-gel derived films of nanomultiferroics-UGC-DAE-CSR Kolkata Centre Project- (**Principal Investigator**)
3. Nanoparticle aggregation behavior in polymer nanocomposites- UGC-DAE-CSR

Kolkata Centre Project-(**Principal Investigator**)

4. Development of one dimensional multiferroic nanocomposites for device applications` under the SRS scheme- KSCSTE-Govt. of Kerala-(**Principal Investigator**)
5. Nano Materials: Synthesis, characterization and applications, DST, New Delhi (**Principal Co-Investigator**)
6. Development of engineered nano-structured materials for high performance applications-DST-Nano Mission-Govt. of India-(**Principal Co-Investigator**)
7. Development of Multi Walled Carbon Nanotube Filled Polycarbonate/ Polypropylene Double Percolating Conductive Polymer Blend Nanocomposites for Electromagnetic Interference Shielding Gaskets for Mobile Phones–DIT-New Delhi-**(Principal Co-Investigator**)

Patents granted/filed

1. A polymer Nanocomposite, Process, And Application there-of , WIPO Publication number: WO2016142848 A1, Publication date: Sep 15, 2016, and Indian patent Application No: 638/DEL/2015 Mohammed Arif P, Sabu Thomas, **Nandakumar Kalarikkal**
2. New Poly(trimethyleneterephthalate) based nanocomposite formulation for EMI Shielding; Patent Application No:201841003767Aswathi M.K, Ajitha A. R., Dr. Sabu Thomas, **NandakumarKalarikkal**, M. Padmanabhan, Lovely P. Mathew
3. MWCNTs reinforced polymer blend nanocomposites of Poly(trimethylene terephthalate) and Polypropylene for EMI shielding application; Patent Application No:201841003768 Ajitha A R, Aswathi M K, Sabu Thomas, **Nandakumar Kalarikkal**, Lovely Mathew P, Geethamma VG
4. Invention of High Performance EMI Shielding Coating From Low Cost Carbon Black with XLPE;Patent Application No: 201841040343; Apparao Gudimalla, Jince Thomas, Dr. Sabu Thomas, **Nandakumar Kalarrikkal**, Zakiah Ahmad
5. Nano Cellulose based EMI shields preparation and thereof; Patent Application No: 201841040344; Deepu A Gopakumar, Avinash R Pai, **Nandakumar Kalarikkal** and SabuThomas
6. Solid one dimensional conducting polymer fibers using electrospinning ; Dr. Sanal Sebastian Payyappilly, Jayesh Cherusseri, Prof. Sabu Thomas, Nandakumar Kalarikkal; Patent Application No:201841040346

Research Collaborations

- Bhabha Atomic Research Centre, Mumbai, India
- Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore, India
- Saha Institute of Nuclear Physics, Kolkata, India
- UGC-DAE Consortium for Scientific Research-Kolkata Centre, Kolkata, India
- Raman Research Institute, Bangalore, India
- Cochin University of Science & Technology, Kochi, India
- Inter University Accelerator Centre, New Delhi, India
- Central University of Kerala, Kasaragod, Kerala, India
- Indian Institute of Science, Bangalore, Karnataka, India

- Indian Institute of Tropical Meteorology, Pune, India
- Institute of Plasma Research, Gandhi Nagar, Gujarat, India
- Walter Sisulu University, South Africa
- Johannesburg University, South Africa
- Jožef Stefan Institute, Ljubjana, Slovenia
- University of Technology- MARA, Malaysia
- University of Lorraine & Institute of Jean Lamour, France
- University of South Brittany, Lorrient, France
- Kansas State University, USA
- North Carolina State University, USA
- Deakin University, Australia
- Stockholm University, Sweden
- Nanyang Technological University, Singapore
- Ariel University, Israel
- Ben Gurion University of the Negev, Israel
- University of Montpellier, France
- Institute of Light Matter, Claude Bernard University Lyon, France
- Lanzhou University, People Republic of China
- LMCP - LIMC - IMA - Centro de Tecnologia II & Universidade Federal do Rio de Janeiro, Brazil

Membership in Professional bodies

- The Indian Physics Association- Life Membership
- Plasma Science Society of India-Life Membership

Other information

- External examiner for M. Sc, M. Phil programs and Ph. D theses evaluator for various Universities in India and abroad.
- Resource person for many workshops, conferences and seminars organized by different colleges, refresher courses, national and international workshops/conferences organized by School of Pure and Applied Physics, International and Inter University Centre for Nanoscience and Nanotechnology of Mahatma Gandhi University and other institutions in India and abroad.
- Reviewer for many international journals.

Hobbies

Music, nature, classical art forms, books, movies, travel, photography, videography, cooking, gardening and bird watching