

Dr. Anup Kumar Nath

Assistant Professor, Dept. of Physics, Cotton University

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PROFILE:

- Highly motivated faculty who wants to learn and get knowledge on recent developments in the fields of materials science.
- Get knowledge by working in different institutions so that the earned knowledge can be disbursed among students to infuse the students with a desire to know more.
- Research experience in energy storage materials, piezoelectric nanomaterials, ion irradiation effects.

EDUCATION: **Tezpur University, Assam, India**

Ph.D. in Physics, 2016

M.Sc. in Physics, 2008 (First class, 7.24 CGPA)

Gauhati University, Assam, India

B.Sc. in Physics 2006 (First class, 71%)

RESEARCH INTERESTS:

- Polymer electrolyte nanocomposites
- Energy storage materials
- Ion irradiation effects

RESEARCH EXPERIENCE:

Tezpur University, India

Ph.D. Candidate, 2011-2016

- *Polymer electrolyte nanocomposites*

Layered silicate based intercalated and exfoliated polymer electrolytes had been prepared with ionic liquids. Intercalation of polymer in the inter-layer galleries of layered silicate had been achieved with the help of ultrasonication. In one system, polyaniline nanofibers have been grown inside the interlayer galleries of montmorillonite (MMT) clay platelets to create hybrid 3D nanofillers and dispersed it in ionic liquid -based polymer electrolyte with a view to utilize favorable properties of both ionic liquid (BMIMBr) and hybrid nanofiller (MMT-PAni nanocomposite). The scaling of ac conductivity confirms that ion concentration and ion diffusion length increases with increasing concentration of nanofiller. Scaling of temperature dependent ac conductivity proves that the ion dynamics follow concept of mismatch and relaxation (CMR) model.

- *Swift heavy ion irradiation effects*

Swift heavy ion (SHI) irradiation is a special technique for inducing physical and chemical modification in bulk materials. High energetic ion beams have been exploited by researchers in different ways in the field of materials science to induce the desired properties in a material. Swift heavy ion (SHI) irradiation can modify the molecular structure in polymers in a controlled way leading to changes in their chemical, electronic, electrical, tribological and optical properties. Swift heavy ion (SHI) irradiation is an up-to-the-minute technique to further improve the ionic conductivity and other properties of polymer electrolytes. The impinging swift heavy ion breaks the polymer chains promoting chain-scission and cross-linking depending upon the fluence leading to change in the electrochemical properties of the undergoing polymer electrolyte. SHI irradiation has been used as a tool to exfoliate the layers of MMT so that the nanocomposite can hinder the crystallization of the polymers leading to increase in conductivity.

Sri Venkateswara College, University of Delhi, India

Project Fellow, 2008-2010

- *Lead free piezoelectric and ferroelectric materials*

Research on lead-free piezoelectric ceramics has been gaining importance due to the environmental concern caused by highly toxic nature of lead-based ceramics. Barium titanate (BaTiO_3) is one of the most studied lead-free materials due to its potential applications as multilayer ceramic capacitors, PTC thermistors, piezoelectric

transducers, actuators, dynamic RAM and a great variety of electro optical devices. In addition, it is showing a good promise as a material for holographic storage and cheap diode lasers. The ferroelectric and piezoelectric properties of tin doped BaTiO₃ have been extensively investigated. Piezoelectric ceramics have potential applications as actuators and sensors in particle accelerators, detectors, microwave devices and in space ships and satellites where the device being used in strong radiation environment which contain an abundance of gamma radiation. Ionizing radiations such as gamma rays is a serious concern because such radiations pass through protective shielding more readily and can change the properties of the materials and hence device performance. So, we have studied the effects of gamma irradiation on the of BaTiO₃ -based ceramics.

TEACHING EXPERIENCE

Cotton University, Department of Physics, India

Assistant Professor, 2020 to till now

- Major Courses:**
- Mathematical Physics
 - Electricity and Magnetism
 - Quantum Mechanics
 - Advanced Solid-State Physics
 - Electromagnetic Theory
 - Plasma Physics

Pub Kamrup College, Department of Physics, India

Assistant Professor, 2017 to 2020

- Major Courses:**
- Waves and Oscillations
 - Electricity and Magnetism
 - Astrophysics
 - Solid-State Physics
 - Electromagnetic Theory

PUBLICATIONS: Total No. of publications: 24, Book Chapters: 02

1. Structural and electrochemical properties of montmorillonite-poly(ethylene oxide) intercalated nanocomposites for lithium-ion batteries.
A.K. Nath, B. Sharma, B.J. Borah, N. Deka, J. Hazarika, International Journal of Polymer Analysis and Characterization 28 (2023) 279-291.
2. Ionic liquid-based novel polymer electrolytes: electrical and thermal properties.
A.K. Nath and Rupam Talukdar, International Journal of Polymer Analysis and Characterization 25 (2020) 597-603
3. Electrochemical and thermal properties of polymer-layered silicate nanocomposites for energy storage applications.
A.K. Nath and B. Sarma, Polymer and Polymer Composites 29 (2021) 547-555
4. 100 MeV Si⁹⁺ swift heavy ion irradiation induced enhancement in electrochemical properties of electrolyte membrane composites based on ionic liquid-polymer-nanocomposite.
A.K. Nath and A. Kumar, Journal of Membrane Science 485 (2015) 30-41
5. Enhancement of electrochemical properties of ionic liquid-based nanocomposite polymer electrolytes by 100 MeV Si⁹⁺ swift heavy ion irradiation.
A.K. Nath and A. Kumar, Ionics 20 (2014) 1711-1721
6. Scaling of AC conductivity, electrochemical and thermal properties of ionic liquid-based polymer nanocomposite electrolytes.
A.K. Nath and A. Kumar, Electrochimica Acta 129 (2014) 177-186
7. Swift heavy ion irradiation induced enhancement in electrochemical properties of ionic liquid based PVdF-HFP-layered silicate nanocomposite electrolyte membranes.
A.K. Nath and A. Kumar, Journal of Membrane Science 453 (2014) 192-201
8. Ionic Liquid based Polymer Electrolyte dispersed with Dedoped Polyaniline Nanorods.
A.K. Nath and A. Kumar, Solid State Ionics 253 (2013) 8-17
9. Ionic transport properties of PVdF-HFP-MMT intercalated nanocomposite electrolytes based on ionic liquid, 1-butyl-3-methylimidazolium bromide.
A.K. Nath and A. Kumar, Ionics 19 (2013) 1393-1403

10. Gamma Ray Irradiation Effects on the Ferroelectric and Piezoelectric Properties of Barium Titanate Ceramics.
Nirmali Medhi and **A.K. Nath**, Materials Engineering and Performance 22 (2013) 2716-2722
11. Effect of gamma ray irradiation on the ferroelectric and piezoelectric properties of barium stannate titanate ceramics.
A.K. Nath and Nirmali Medhi, Radiation Physics and Chemistry 91 (2013) 44-49
12. Piezoelectric properties of environmental friendly bismuth doped barium titanate ceramics.
A.K. Nath and Nirmali Medhi, Materials Letters 73 (2012) 75-77
13. Density variation and piezoelectric properties of Ba(Ti_{1-x}Sn_x)O₃ ceramics prepared from nanocrystalline powders.
A.K. Nath and Nirmali Medhi, Bulletin of Materials Science 35 (2012) 847-852
14. Barium titanate nanoparticles produced by planetary ball milling and piezoelectric properties of corresponding ceramics
K. Chandramani Singh, **A.K. Nath**, Materials Letters 65 (2011) 970-973
15. Structural, electrical and piezoelectric properties of nanocrystalline tin-substituted barium titanate ceramics.
K. Chandramani Singh, **A.K. Nath**, Radhapiyari Laishram, O.P. Thakur, Journal of Alloys and Compounds 509 (2011) 2597-2601
16. Ferroelectric, piezoelectric and electrostrictive properties of Ba(Ti_{1-x}Sn_x)O₃ ceramics obtained from nanocrystalline powder.
A.K. Nath, K. Chandramani Singh, Radhapiyari Laishram, O.P. Thakur, Materials Science and Engineering B 172 (2010) 151-155
17. Influence of ball milling parameters on the particle size of barium titanate nanocrystalline powders.
A.K. Nath, Chongtham Jiten, K. Chandramani Singh, Physica B 405 (2010) 430-434
18. Effect of ball milling time on the electrical and piezoelectric properties of barium titanate ceramics.
A.K. Nath, Chongtham Jiten, K. Chandramani Singh, Radhapiyari Laishram, O. P.Thakur, D. K. Bhattacharya, Integrated Ferroelectrics 116 (2010) 51-58
19. Electrical and piezoelectric properties of lead-free (K_{0.5}Na_{0.5})(Nb_{0.9}Ta_{0.1})O₃ ceramics prepared from nanopowders.
Chongtham Jiten, **A.K. Nath**, K. Chandramani Singh, Radhapiyari Laishram, O.P. Thakur, D.K. Bhattacharya, Integrated Ferroelectrics 118 (2010) 1-7
20. Ionic conduction and phase separation studies in P(VdF-HFP)-LiClO₄-dedoped polyaniline nanofiber composite polymer electrolytes - II: Effect of incorporation of PC and DEC.
A. K. Nath, M. Deka and A. Kumar, Indian Journal of Physics 84 (2010) 1307-1313
21. Ionic conduction and phase separation studies in PEO-P(VdF-HFP)-LiClO₄-dedoped polyaniline nanofiber composite polymer electrolytes – I.
M. Deka, **A.K. Nath** and A. Kumar, Indian Journal of Physics 84 (2010) 1299-1305
22. Effect of dedoped (insulating) polyaniline nanofibers on the ionic transport and interfacial stability of poly(vinylidene fluoride-hexafluoropropylene) based composite polymer electrolyte membranes.
M. Deka, **A.K. Nath**, A. Kumar, Journal of Membrane Science 327 (2009) 188-194
23. Effects of gamma ray irradiation on the piezoelectric and ferroelectric properties of bismuth doped barium titanate ceramics.
A.K. Nath and A. Medhi, Indian Journal of Physics 89 (2015) 131-136
24. Synthesis and characterization of polymer-layered silicate based single ion conductor for rechargeable battery applications.
R. Talukdar, **A.K. Nath** and A. Kumar, Research Journal of Contemporary Concerns 9 (2014) 109-117

BOOK CHAPTERS:

1. Polymer Nanocomposites for Futuristic Energy Storage Applications.
A.K. Nath and J.M. Kalita, Handbook of Consumer Nanoproducts (2022), Springer Nature, Singapore
2. Synthesis and Characterization of MgO Nanoparticle and Its *In-Vitro* Cytotoxic Effect on Erythrocytes
Bitopan Boro, **Anup Kr. Nath**, Manash Barthakur, and Pankaj Kalita, Advances in Bioprocess Engineering and Technology (2021), Springer Nature, Singapore

SEMINAR, CONFERENCE AND WORKSHOP ATTENDED:

1. Physics UG-CBCS Workshop, Organized by Gauhati University, 4-5 July, 2019.
2. Two Days Workshop on E-learning, MOOCS and E-Content development, Organized by Pub Kamrup College, 1-2 February, 2019.
3. National seminar on Science and Technology for Human welfare, Organized by Institute of Advanced Studies in Science and Technology (IASST), Guwahati, 27 February, 2017.

- National Seminar on Recent Trends of Research in Science and Technology, Cotton College, Guwahati, 29 March, 2014 (Oral Presentation)
- Fifth International Conference on Electroactive Polymers: Materials and Devices (ICEP 2012), Banaras Hindu University, Varanasi, India, November 4-9, 2012 (Oral Presentation)
- International Conference on Electroceramics, University of Delhi, Delhi, India, December 13-17, 2009 (Poster Presentation)
- Condensed Matter Days- 2008, Viswa Bharti, Santiniketan, India, August 29-31, 2008 (Oral Presentation)
- Condensed Matter Days-2006, Tezpur University, India, August 29-31, 2006
- International Seminar on Frontiers in Polymer Science and Technology, Guwahati, India, November 1-3, 2007
- Research in Physics 2012 and The Role of IPR, 1st In-House Symposium, Department of Physics, Tezpur University, Tezpur, India, December 21, 2012 (Poster Presentation)
- Contemporary Physics and the role of IPR, 2nd In-House Symposium, Department of Physics, Tezpur University, Tezpur, India, February 7, 2014 (Oral Presentation)

INVITED TALK:

- Invited talk on “Nanotechnology, an emerging field”, invited by Royal Global University, Assam, 17 June, 2022.
- Popular Talk on “XRD and SEM: Our eye to Nanomaterials”, webinar organized by DHSK College, Assam, 25 August, 2020.
- Invited Talk on “Paraphernalia of Physics in Nanotechnology” Webinar organized by Jawaharlal Nehru College, Arunachal Pradesh, India, 7 August, 2020.
- Popular Talk on “Conceptual Evolution of Light”, invited by Dept. of Physics, S.B.M.S. College, Assam, 10 April, 2019.

COLLABORATIVE RESEARCH PROJECTS:

Studies on swift heavy ion induced modifications in 2D layered nanosheets for energy harvesting applications, collaboration with Inter University Accelerator Centre (IUAC), New Delhi (2021).

RESEARCH GUIDANCE: 2 PhD students working in the fields of energy storage materials.

OTHER DUTIES:

- Member of Cotton University Pelletron Accelerator Centre (Upcoming project).
- Member of Cotton University Placement Cell (2021-till now).
- Prepared Project Proposal for submission in DST-FIST on behalf of the department of Physics, Cotton University.
- Joint Convener of Science Centre, Pub Kamrup College (2018-2020).
- Assistant Coordinator of Internal Quality Assurance Cell (IQAC) of Pub Kamrup College (2019-2020).

CAREER DEVELOPMENT COURSES ATTENDED:

- UGC Sponsored Refresher Course on Physical Sciences and nano Sciences, organized by Human Resource Development Centre, Jawaharlal Nehru University, New Delhi, 10-22 January, 2022.
- AICTE Training And Learning (ATAL) Academy Online Elementary Faculty Development Program on “One Week Online Faculty Development Program on Photonics”, 20-24 September, 2021.
- UGC Sponsored Orientation Program, organized by Human Resource Development Centre, North Eastern Hill University (NEHU), Shillong, India, 18 February to 17 March, 2019.

REVIEWER OF JOURNALS:

1. Physica B, Elsevier
2. Materials Letters, Elsevier
3. Ionics, Springer
4. Journal of Materials Science, Springer
5. Indian Journal of Pure and Applied Physics, NISCAIR
6. Nuclear Instruments and Methods in Physics Research Section B: Beam Interactions with Materials and Atoms, Elsevier

INSTRUMENTAL AND ANALYTICAL SKILLS

1. X-ray Diffractometer
2. Transmission Electron Microscope (TEM)
3. Scanning Electron Microscope (SEM)
4. Strain Measurement System
5. P-E Loop Tracer
6. High Energy Ball Mill
7. LCR Meter
8. Thermogravimetric Analysis (TGA)
9. Ultrasonic Processor
10. Electrochemical Workstation
11. FTIR

LIFE MEMBER OF THE FOLLOWING BODIES

1. Indian Association of Physics Teachers
2. Physics Academy of the North East (PANE)
3. Assam Physical Society

- WORK STYLE:**
- Willing to perform basic tasks and move on to solve complex problems
 - Able to learn new knowledge and adapt to new environments quickly
 - Strong independent work style and excellent teamwork skills
 - Well-organized and passionate