Arabinda Nayak

Curriculum Vitæ (October 25, 2018)

Address

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APPOINTMENTS

Dean of Faculty of Natural and Mathematical Sciences 2016-
Presidency University, Kolkata

Professor of Physics 2012-
Presidency University, Kolkata

Associate Professor of Physics 2009-2012
Presidency College, Kolkata (2009-2010)
Presidency University, Kolkata (2010-2012)

Reader in Physics 2006-2009
Presidency College, Kolkata

Lecturer (Sr. Scale) in Physics 2002-2006
Presidency College, Kolkata

Lecturer in Physics 1997-2002
Darjeeling Govt. College, Darjeeling

Lecturer in Physics 1996-1997
North Regional Institute of Science & Technology, Nirjuli, AP

Postdoctoral Fellow (RA, CSIR) 1993-1996
Material Science Center, IIT Kharagpur

Research on the preparation and characterization of Diamond and Diamond-Like-Carbon (DLC) Films

EDUCATION

PhD Materials Science 1988-1993
Materials Science Center, IIT, Kharagpur
"Studies on Structural, Electrical and Optical Properties of Electron Beam Deposited Zn_3P_2-Cd_3P_2 Thin Films"
Thesis advisors: Professor D.R. Rao and Professor H.D. Banerjee

MSc Physics (5-year Integrated) 1982-1987
Department of Physics, IIT, Kharagpur

NATIONAL ELIGIBILITY TEST STATUS

- Joint CSIR - UGC NET (1988)
- GATE (1988)

SOCIETY MEMBERSHIP

- Life member, Indian Association for the Cultivation of Science, Kolkata
- Life Member, Materials Research Society of India (MRSI)

FIELD OF SPECILZATION

- Experimental Condensed Matter Physics & Materials Science

MAJOR RESEARCH INTEREST

- Synthesis and Evaluation of Thin Films
- Development of Ge and ZnO-based nanomaterials
- Diamond & Diamond-Like-Carbon Films
- Polymer-Inorganic Hybrid nanocomposites
- Development of Zinc-Tin-Phosphide based chalcopyrites thin films for solar cell application
- Multi-junction Solar Cells
- Computational Materials Science & Optical Response of Functional Materials

MY RESEARCH LABORATORY

- I have set up one Solid State and Materials Science research laboratory for the deposition and evaluation of ultra fine (down to 5 nm) germanium (Ge) particles, ZnO nanocrystals, thin film and crystalline compound semiconductors and conducting polymer-inorganic hybrid nanocomposites for device applications. The equipped with an Ionized Cluster Beam (ICB) deposition system for the growth of Ge nanoparticles (funded by DST, Govt. of India). Recently, one Bridgman growth apparatus has been installed for the growth of ZnSnP2 single crystal (funded by UGC).

- An experimental set up for the measurement of ac conductivity and dielectric response for the nanocomposite materials at elevated temperatures has also been designed by me and fabricated under the FRPDF grant provided by the Presidency University.
- The laboratory also equipped with supporting instruments for material preparation such as Centrifuge (up to 5000 rpm), Spin Coating system, UV light source (200 W), magnetic stirrer with hot plate etc. (purchased from FRPDF grant).

SUPERVISING OF RESEARCH SCHOLARS FOR Ph.D DEGREE

1. **Tamaghna Maitra (NET, UGC).** Research Proposal: Metalorganic Vapor Phase Epitaxial (MOVPE) growth of Ge/$In_xGa_{1-x}P$ multi quantum wells
2. **Sukhendu Mukherjee (NET, UGC Project).** Research Proposal: Development, Synthesis and Characterization of $ZnSnP_2$ Chalcopyrite Thin Film for Photovoltaic Devices
3. **Banasree Sadhukhan (Part time)**. Research Proposal: Optical conductivity and dielectric function of NiPt alloy systems. (Submitted, 2018).

SUPERVISION OF JRF/SRF

- **Ipsita Halder (SRF, CSIR, 2015-2015). Research: Dielectric, ac conductivity relaxation and magnetoresistive behaviors of $BaTiO_3$-ppy nanocomposites**
  Research Finding: Nano crystalline $BaTiO_3$ and polypyrrole (ppy)-$BaTiO_3$ hybrid nanocomposites have been synthesized using chemical oxidative polymerization method. Microstructure and crystallinity of the hybrids are studied using field emission scanning electron microscope (FE-SEM), high resolution transmission electron microscope (HRTEM) and X-ray diffraction (XRD) technique. As prepared $BaTiO_3$ are rod-like, while PPY-$BaTiO_3$

nanocomposites indicate the formation of bulging agglomerates of spherical particles with various sizes (40-50 nm). Dielectric constants at room temperature of the composites have largely enhanced (up to 6000). The hybrid composite shows grain boundary relaxation in the frequency range (42 Hz-5 MHz). Three dimensional (3D) variable range hopping (VRH) with high localization of charge carriers (Mott temperature ≈ 8725658 K) is observed in the temperature dependent conductivity evaluation of composite system. Negative magnetorestance (MR ≈ 4.3%) has been measured at 1 T. The observed MR is explained with the help of forward interference model.

MAJOR RESEARH PROJECT (COMPLETED)

- **Development of Tetragonal Ge-nanocrystals by Ionized Cluster Beam Deposition Technique: A New Light Emitting Materials for Future Optoelectronic.**

  Sponsoring Authority: DST, Govt. of India. D. D. No. SR/ S2/ CMP - 53/ 2003.
  Amount: 24 Lakh. Duration: 11/10/2006 to 10/10/2009.

  Research Finding: We have successfully deposited Ge-NCs on Si (100) and quartz substrates by ICB deposition technique developed in our laboratory. Ge nanocrystals mostly with tetragonal phase were obtained when grown using neutral cluster. A composite phase containing both tetragonal and high percentage of diamond cubic structure of Ge-NCs could be grown when the clusters were ionized and subsequently accelerated with potential greater than 1.50 kV. HRTEM techniques were used to study the microstructure of the crystallites. Optical band gap of the Ge-films were in the range 1.55 eV-1.60 eV. The UV light illumination has a pronounced effect on the optical spectra of the non-cubic Ge-NCs.

  Germanium nanocrystals embedded between amorphous Al2O3 layers deposited by ICB deposition technique exhibited distinct microcrystalline structures with progressively lowering of disorder with thermal treatment. Such NCs are promising for the non-volatile memory devices.

- **Polymer-Inorganic Hybrid Nanocomposites - Preparation, Characterization and their Potential as Nanodielectrics.**

  Sponsoring Authority: CSIR, New Delhi. Sanction No: CSIR-01(2342)/09/EMR-II.

  Amount: 13.68 Lakh. Duration: from 01.11.2009 to 31.10.2013. (In collaboration with Department of Chemistry).

  Research Finding: A nanocomposite of PNVC and nano-dimensional Fe_3O_4 (PNVC-Fe_3O_4) was prepared by insitu solid state polymerization of N-vinylcarbazole by Fe_3O_4 at 65°C. PPY encapsulated PNVC-Fe_3O_4 nanocomposite was synthesized via polymerization of PY in an aqueous suspension of PNVC-Fe_3O_4 composite in presence of KPS. The formations of PNVC and of PPY in the PPY-(PNVC-Fe_3O_4) system were confirmed by FTIR analysis. TGA and DTA analyses showed the thermal stability trend as Fe_3O_4 > PNVC-Fe_3O_4> PPY-(PNVC-Fe_3O_4)> PNVC. HRTEM studies revealed that the PPY-(PNVC-Fe_3O_4) nanoparticles have an average grain size of 37 nm with the Fe_3O_4 nanoparticles fairly well-dispersed in the composite matrix. The SEM study showed a spherical morphology of PPY-(PNVC-Fe_3O_4) particles. XRD studies also confirmed the particle size to be 37 nm. The dielectric constants of PNVC-Fe_3O_4 and the PPY-Fe_3O_4 systems (110-400) were improved relative to the base polymers. In contrast, the PPY encapsulated PNVC-Fe_3O_4 nanocomposites showed significantly higher values of dielectric constant (>1000). The interfaces between polymer and oxide layers play crucial roles for enhancing dielectric properties of the system. The ac conductivity was found to be independent of frequency in the range 10^2 to 10^3 Hz for all the nanocomposites and rise thereafter appreciably in the frequency range of 1 kHz to 25 kHz.

MAJOR RESEARH PROJECT (COMPLETED)

- **Development, Synthesis and Characterization of $ZnSnP_2$ Chalcopyrite Thin Film for Photovoltaic Devices.**

  Sponsoring Authority: UGC, New Delhi. Sanction No.MRP-MAJOR-MATE-2013-16190.

  Amount: 11.91 Lakh. Duration: from 01.07.2015 to 31.06.2018.

$ZnSnP_2$, a member of II-IV-V_2 group compound semiconductors, has recently attracted much attention as a potential absorbing material for thin film solar cell applications. Recent theoretical calculations on the electronic structure of $ZnSnP_2$ indicate thatit possesses an order chalcopyrite structure which can transform to a disordered sphalerite structure at high temperature (720^0C) with a variation of room temperature optical band gaps from 1.70 eV to 0.75 eV. In the chalcopyrite structure (bandgap =1.70 eV), Zn and Sn occupy on specific sites of the fcc lattice, while in the sphalerite structure (bandgap = 0.75 eV) they are randomly distributed on fcc sites giving rise to disorder phase. This feature indicates that bandgap of $ZnSnP_2$ could be tuned from 0.75 eV to 1.70 eV by controlling growth temperature and hence the atomic configuration. The grading of band gaps from low to high values could be achieved by growing an initial layer at a higher temperature corresponding to lower band gap and then the subsequent layers are grown at relatively lower temperatures. The exact growth temperatures and their relation to the band gap values of $ZnSnP_2$ need to be optimized properly. Thus, the band gap tuning facilitates the fabrication of various homo p-n junctions by properly choosing a definite phase of $ZnSnP_2$ and doping. Interestingly, an optical band gap of 1.68 eV, which is close to the optimum band gap (~ 1.50 eV) at the Schockley-Quisser limit, has been reported. Moreover, other advantages such as ternary $ZnSnP_2$is low-toxic, the constituent elements for the preparation of $ZnSnP_2$are earth abundant and inexpensiveand high absorption coefficient (> 10^4 cm^{-1}) above 1.60 eV, find $ZnSnP_2$ a potential alternative for photovoltaic device applications.It has excellent lattice matching with GaAs substrates. Thegrowth of $ZnSnP_2$thin films have been reported previously by co-evaporation and in ultrahigh vacuum by molecular beam epitaxy (MBE). Recently, $ZnSnP_2$ based thin-film solar cell with $ZnSnP_2$ absorber is fabricated by phosphidation method under the variation of Zn/Sn atomic ratio. The solar cell parameters (J_{SC} = 2.63 mA/cm^2, V_{OC} -=3.7 mV, FF = 27.2%, and conversion efficiency = 0.0027%) have been measured using near-stoichiometric $ZnSnP_2$ as the absorber layer. In the study, the authors found two different current areas. Low-current area is attributed to the presence of Zn_3P_2 secondary phase forming the shunt paths while the high-current area (0.014 cm^2) with efficiency = 0.021%, J_{SC} = 5.03 mA/$cm^2$is obtained due the formation of pure $ZnSnP_2$ phase. The energy band gap of $ZnSnP_2$ thin film prepared by phosphidation method was reported as 1.38 eV indicating the growth of sphalerite $ZnSnP_2$ structure with appropriate variation of Zn/Sn atomic ratio. In few cases, J–V characteristics of the hetero-junction solar cell [Al/AZO/ ZnO/CdS/$ZnSnP_2$/Mo] have been studied. The performance of the fabricated cell was found quite low (conversion efficiency is 0.087%). Necessary modifications of the cell structure to achieve better performances such as improvement of the resistance of the hetero-interfaces and the use of appropriate buffer materials have been suggested.

Though some limited studies have been made by several researchers on the preparation of crystalline bulk material and thinepitaxial layer, detailed understanding of optical and electrical properties, the nature of native defects responsible top-type conductivity in $ZnSnP_2$ are still obscure. In $ZnSnP_2$ thin film, zinc vacancies or zinc-on-tin sites are considered as acceptor which is responsible for p-type conductivity. Defects introduce localized levels in the energy gap of $ZnSnP_2$ and other compound semiconductors through which they control solar cell device performance, efficiency and reliability. Native defects such as vacancies, self-interstitials, and antisite defects often act as unintended dopants or compensate intentionally introduced dopants of these materials. In addition, native defects as well as contaminant impurities also limit the efficiency of light-emission in $ZnSnP_2$ and related materials. Thus, it is of great significance to study the nature and behaviour of such defects under different conditions.

OTHER COLLABORATIVE RESEARCH PROJECTS (ON GOING)

1. **Metalorganic Vapor Phase Epitaxial (MOVPE) growth of $Al_{0.3}Ga_{0.7}As$/GaAs multi quantum wells (MQW) (in collaboration with Dr. S. Bhunia, Surface Physics & Materials Science Division, SINP, Kolkata)**

   Proposal: Nowadays the use of "quantum devices" based on compound semiconductors has caused a great impact on our daily life. Very high end conceptual devices based on quantum wells such as quantum cascade lasers (QCL), vertical cavity surface emitting lasers (VCSEL), quantum well infrared photodetectors (QWIP), resonant tunneling diodes (RTD) etc have been demonstrated. The quantum wells employed in such devices need to be of high quality, and precisely controlled thickness. High quality refers to smooth interfaces, few non-intentional incorporated impurities and high photoluminescence efficiency. Such high quality QWs are also important in realizing two-dimensional electron gases and studying physical phenomena associated with them. In this project work, we will study MOVPE growth of $GaAs/Al_{1-x}Ga_xAs$ QWs and study the effect of interface roughness on their optical emission properties.

2. **Temperature dependent dielectric properties and ac conductivity relaxation in $NiO.V_2O_5$ - PEDOT nanocomposites (in collaboration with Dr. U.C. Ghosh, Former Associate Professor, Department of Chemistry, Presidency University).**

   Proposal: Triclinic nickel vanadium mixed oxide ($NiO.V_2O_5$) with particle size 80-120 nm will be synthesized via combined sol-gel-incineration method. This mixed oxide will be reinforced into the polyethylene dioxythiophene (PEDOT) matrix and characterized using x-ray diffraction (XRD), high resolution transmission electron microscopy (HRTEM), Fourier transform infrared spectroscopy (FTIR) and temperature dependent dielectric constant and ac conductivity measurements. The roll of thermally activated polarons with different activation energies on the electrical conduction in the PEDOT – $NiO.V_2O_5$ nanocomposite will be investigated.

3. **Preparation, characterization and dielectric, ac conductivity with electrochemical behavior of strontium zirconate (in collaboration with Dr. U. C. Ghosh, Former Associate Professor, Department of Chemistry, Presidency University).**
4. **Microstructural, electrical relaxation and magnetic characteristics of $GdFeO_3$-$SmFeO_3$ mixed improper multiferroic materials (for MSc project).**
5. **(A) Effect of disorder on the optical response of NiPt and Ni_3Pt alloys & (B) Band-gap tuning and optical response of two-dimensional Si_xC_{1-x}: A first-princles real-space study of disordered two-dimensional materials (in collaboration with Prof. Abhijit Mookerjee, Professor Emeritus, S.N. Bose National Center for Basic Sciences, Kolkata).**

Proposal: In this theoretical and computational studies, we proposed a detailed study of the effect of chemical disordere on the optical response of $Ni_{1-x}Pt_x$ (0.1 < x < 0.75) and $Ni_{3(1-x)/3}Pt_x$ (0.1 < x < 0.3). We shall propose a formalism which will combine a Kubo-Greenhood approach with a DFT based tight-binding linear muffin-tin orbitals (TB-LMTO) basis and augmented space recursion (ASR) technique to explicitly incorporate the effect of disorder. We will examine that the chemical disorder has a large impact on optical response of Ni-Pt systems. This same approach will be used to quantitatively analyze the effect of chemical disorder on Si_xC_{1-x} beyond the usual Dirac-cone approximation.

6. **Development of $KBiFe_2O_5$ film for visible light absorbing multiferroic and photovoltaic material: Influence of confining narrow band gap nanoparticles (for Major Research & MSc project).**

Proposal: This research proposal is mainly directed towards the fabrication and characterization of photovoltaic material and device based on the thin polycrystalline films of multiferroic $KBiFe_2O_5$ (KBFO) whose photovoltaic properties are less studied and understood. Unlike a conventional p-n junction solar cell, the photovoltaic effects in the multiferroic material (like KBFO) is relied on the internal electric field mainly responsible for the separation of photo-generated electron-hole pairs and thereby allows photovoltage higher than the optical bang gap of such materials. KBFO films will be deposited on Indium Tin Oxide coated glass and crystalline silicon substrates using spin coating technique with subsequent heat treatment for proper nucleation. Microstructural information will be obtained from X-ray diffraction and transmission electron microscopic studies. On the other hand, optical spectroscopic measurements will be undertaken to determine the absorption coefficient and band gap of the as-grown KBFO films. In this proposed project, we are mainly interested to study the enhancement of photocurrent and spectral response of the Al- $KBiFe_2O_5$–Al structure by embedding narrow band gap (1.2 – 1.3eV) oxide based nano-sized semiconductors (CuO, Ag_2O) in the middle of the $KBiFe_2O_5$ layer. The fabricated structure not only absorbs more light from visible spectrum for electron-hole pair production but also help to separate them by forming local p-n heterojunction and lowering the possibility of screening the electric charge carriers. This noble structure with embedding small gap materials is expected to generate more photocurrent with compare to the bare $KBiFe_2O_5$ (KBFO) single layer. The $KBiFe_2O_5$ (KBFO) film and source material CuO/Ag_2O for embedding layer will be prepared from the nitrate/hydroxide of their constituent elements by chemical routes. Thermal or electron beam evaporation technique to be utilized for growth of embedding layer (CuO/Ag_2O) and necessary electrodes (rectangular or disk shaped) for electrical measurements.

UNDERGRADUATE & POST GRADUATE PROJECTS SUPERVISED

1. Growth, Structural and Electrical Characterization of Zinc Tin Phosphide Thin Films for Solar Cell Applications (Kiyafa Sultana, MSc, 2013).
2. Growth and Optical Characterization of Zinc Tin Phosphide Thin Films for Solar Cell Applications (Santanu Adikary, MSc, 2013).
3. Synthesis and microstructural Behaviour of Doped Bismuth Titanate ($Bi_4Ti_3O_{12}$) as Nano Multiferroic Materials (Arinda Ghosh, MSc, 2014).
4. Magnetic and Electrical Characterization of Doped Bismuth Titanate ($Bi_4Ti_3O_{12}$) Nano Multiferroic Materials (Sourav Kumar Maji, MSc, 2014).
5. ZnO-Nanorods based Dye Sensitized Solar Cells: Preparation and Implementation (Sucharita Saha, MSc, 2015).
6. Metal Organic Vapour Phase Epitaxial Growth of $(Al_yGa_{1-y})_zIn_{1-z}P/(Al_xGa_{1-x})_zIn_{1-z}P$ Quantum Wells and Study the Effect of Interface Roughness and Alloy Disorder on its Light Emission Properties (Chandralina Patra, MSc, 2015).
7. X-ray reflectivity analysis of semiconductor multilayer: structural and morphological characterization (Kaustav Dutta, MSc, 2016).
8. Solving Poisson Equation using FFT: Numerical Solutions of Electrostatic Potentials (Swadhiti Majhi, BSc, 2016).
9. Study of Equilibrium State of Matter using Molecular Dynamics and Calculation of Thermal Conductivity (Kanaya Malakar, BSc, 2016).
10. Study of Brownian Motion under Asymmetric Periodic Potential Well (Unmesh Ghorai, BSc, 2017).
11. Electric and Magnetic Properties of Cr Doped $GdFeO_3$ Multiferroic Perovskite (Mainur Rahaman, MSc, 2017).

12. Realization of Topological Darkness in Nanostructured Plasmonic Materials (Sonali Saha, BSc, 2018)
13. Photovoltaic Effect in Multiferroic $KBiFe_2O_5$(Pradip Singha Roy, MSc, 2018).

NOW TEACHING (UNDER GRADUATE & POST GRADUATE)

- PHYS0191: Mathematical Methods-1 (UG, Odd Semester)
- PHYS0401: Mathematical Methods-2 (UG, Even Semester)
- PHYS0301: Electromagnetism 1 (UG, Odd Semester)
- PHYS0491: Physics Laboratory-3 (UG, Even Semester)
- PHYS0803: Solid State Physics 2 (PG, Even Semester)
- PHYS0902: Condensed Matter Physics-2 (PG, Odd Semester)
- PHYS0904: Physics of Nanostructured Materials (PG, Odd Semester)
- PHYS0992: MSc Advanced Laboratory (PG, Odd Semester)

I try to teach all the courses methodically and coherently so as to make the contents enjoyable and acceptable to all students.

PEER-REVIEWED JOURNAL PAPERS

1. **Nayak, A.,** Rao, D.R., and Banerjee, H.D. (1991) Optical Studies on Electron Beam Deposited Zn_3P_2 Thin Films. *J.Mater.Sci.Lett.* Vol. **10**, P.403 - 405.

2. **Nayak, A.,** Rao, D.R., and Banerjee, H.D. (1991) Electrical and Optical Properties of e-Beam Evaporated Zn_3P_2 Thin Films. *Bull. Electrochem*. Vol.**7**, P. 133 - 135.

3. **Nayak, A.,** Rao, D.R., and Banerjee, H.D. (1991) Derivative Spectra of Polycrystalline Zn_3P_2 Thin Films. *Solid State Comm.,* Vol.**78**, P. 149 – 151.

4. Rao, D.R., **Nayak, A.** (1992) Preparation and Characterization of Zn_3P_2 – Cd_3P_2 Solid Solutions. *J. Mater.Sci.* Vol. **27**, P. 4389- 4392.

5. **Nayak, A.** and Rao, D.R. (1992) Optical Constant of Zn_3P_2 – Cd_3P_2 Thin Films. *Optical Materials,* Vol. **1**, P. 85 – 89.

6. Rao, D.R., **Nayak, A. (**1993) Preparation and Characterization of Cd_3P_2 Thin Films. *J. Appl. Phys.*, Vol. **74**, P. 214 - 218. Doi: 10.1063/1.354148.

7. **Nayak, A.** and Rao, D.R. (1993) Photoluminescence Spectra of Zn_3P_2 – Cd_3P_2 Alloy Films. *Appl. Phys. Lett.,* Vol. **63**, P. 592 – 593. Doi: 10.1063/1.110779.

8. **Nayak, A.** and Rao, D.R. (1994) Electrical Properties of Electron Beam Evaporated Zn_3P_2 – Cd_3P_2 Alloy Films. *Matter. Chem. & Phys.,* Vol. **37, P.** 225 – 229

9. **Nayak, A.** and Banerjee, H.D. (1995) Bonding Characteristics and Optical Properties of Amorphous Carbon/Diamond Films Deposited by Electron Beam Activated Plasma CVD Method. *Phys. Stat. Sol (a).* Vol. **149**, P. 629 – 635.

10. **Nayak, A.** and Banerjee, H.D. (1995) Electron Beam Activated Plasma Chemical Vapour Deposition of Polycrystalline Diamond Films. *Phys. Stat. Sol (a).* Vol. **151**, P. 107 –111.

11. **Nayak, A.** and Banerjee, H.D. (1997) Bonding and Optical Properties of Diamond Like Hydrocarbon Films Deposited by Plasma Decomposition of Acetylene: The Role of Water Vapour Addition. *Mater.Chem. & Phys.,* Vol. **47**, P. 159 - 163.

12. **Nayak, A.** and Banerjee, H.D. (1997) Photoluminescence Spectroscopic Investigation on the Quality of Diamond Films Grown in Oxy-Acetylene Combustion Flame. *Thin Solid Films,* **Vol. 298**, P. 14 – 21. Doi: 10.1016/S0040-6090(96)09139-0.

13. **Nayak, A.** and Banerjee, H.D. (1999) X-Ray Photoelectron Spectroscopy of Zinc Phosphide Thin Films. *Appl. Surf. Sci.,* Vol. **148**, P. 205 – 210.

14. **Nayak, A.** and Banerjee, H.D. (1999) X-Ray Photoelectron Spectra of Zn_3P_2 – Cd_3P_2 Alloy Semiconducting Thin Films.*Matter.Chem & Phys.,*Vol. **60,** P.95-98.

15. Halder, S.R., **Nayak, A.**, Chini, Roy, S.K., Yamamoto, N.And Bhunia, S. (2009) Vapor condensation growth and evaluation mechanism of ZnO nanorod flower structures. *Phys. Stat. Sol. (a),*Vol. **207**, P.364 – 369. doi: 10.1002/ pssa.200925223.

16. Halder, S.R., **Nayak, A.**, Chini, T.K. and Bhunia, S.(2010) Strong temperature and substrate effect on ZnO nanorod flower structures in modified chemical vapor condensation growth. *Current Appl. Phy.,* Vol. **10,** P.942 – 946. doi:10.1016/j-cap.2009.11.077.

17. Haldar, I., Kundu, A., Biswas, M., and **Nayak, A.** (2011) Preparation and evaluation of a poly (N-vinylcarbazole) – Fe_3O_4 (PNVC-Fe_3O_4) nanocomposite. *Matter.Chem & Phys.,* Vol. **128,** P. 256 – 264. doi: 10.1016/j.matchemphys.2011.03.008.

18. Haldar, I., Biswas, M., and **Nayak, A.** (2011) Microstructure, dielectric response and electrical properties of polypyrrole modified poly (N-vinylcarbazole) – Fe_3O_4 (PNVC - Fe_3O_4) nanocomposites. *Synthetic Metals,* Vol. **161**, P. 1400 – 1407. doi: 10.1016/j-synthmet. 2011.05.008.

19. Haldar, I., Biswas, M., and **Nayak, A.** (2012) Preparation and evaluation of microstructure, dielectric and conductivity (ac/dc) characteristics of a polyaniline/ poly N-vinylcarbazole/ Fe_3O_4 nanocomposites. *J. Polym. Res.,* Vol. **19**, P. 9951:1-9.doi:10.1007/s10965-012-9951-0.

20. Haldar, I., Biswas, M., **Nayak, A.** and Sinha Ray, S. (2012) Morphological, dielectric and electrical conductivity characteristics of clay-containing nanohybrids of poly (N-vinylcarbazole) and polypyrrole. *J. Nanosci. Nanotech.,* Vol. **12**, P. 7841 – 7848. doi: 10.1166/jnn.2012.6589.

21. Haldar, I., Biswas, M., **Nayak, A.** and Sinha Ray, S. (2013) Dielectric Properties of Polyaniline-Montmorillonite Clay Hybrids. *J. Nanosci. Nanotech.,* Vol. **13 (1-6)**, P. 1824-1829. doi: 10.1166/jnn.2013.7125.

22. **Nayak, A.** and Bhunia, S. (2014) Microstructure and dielectric functions of Ge nanocrystals embedded between amorphous Al_2O_3 films: study of confinement and disorder. *J. Exptl. Nanosci.*, **Vol.9 (5),** P. 463-474. doi:10.1080/ 17458080.2012.669852.

23. Haldar, I., Biswas, M., and **Nayak, A.** (2014) Dielectric and Conductivity Characteristics of $CuCl_2$ Doped Poly (N-vinyl carbazole) and Its Hybrid Nanocomposites with Fe_3O_4. *J. Nanosci. Nanotech.,* **Vol. 14 (N.8)**, P. 5774-5778. doi: 10.1166/jnn.2014.8885.

24. Haldar, I., Biswas, M., and **Nayak, A.** (2014) Some Observations on the Dielectric and Conductivity Behavior of Nanocomposites of Polyaniline with Fe_3O_4 and $CuFe_2O_4$. *Polymer-Plastics Technol. & Engg.,* **Vol. 53***,* P. 1317-1326. doi: 10.1080/ 03602559.2014.886118.

25. Sarkar, S.K., Raul, K.K., Pradhan, S.S., Basu, S., **Nayak, A.** (2014) Magnetic Properties of Graphite Oxide and Reduced Graphene Oxide. *Physica E,* Vol. 64, P. 78-82. doi: 10.1016/j-physe.2014.07.014.

26. Mukherjee, S., Pradhan, A., Mukherjee S., Maitra, T., **Nayak, A.,** Bhunia, S. (2015) Growth and Characterization of Cubic and Non-Cubic Ge Nanocrystals. *AIP Conf. Proc* **Vol. 1728**, P. 0220111-1-020111-5; doi:10.1063/1.4946162.

27. Pradhan, A., Maitra, T., Mukherjee, S., Mukherjee S., **Nayak, A.,** Satpati, B., Bhunia, S. (2015) Observation of Natural Superlattice in $Al_xGa_{1-x}As$ Layers Grown by Metalorganic Vapour Phase Epitaxy. *AIP Conf. Proc* **Vol. 1728**, P. 020243-1-020243-6; doi:10.1063/1.4946294.

28. Samanta, S., Jana, K., Gupta, K., **Nayak, A**., Ghosh, U.C. (2016) NiV_2O_6-incorporated poly-(3, 4-ethylenedioxythiophene) polymer nanocomposite: synthesis, characterization, temperature dependent dielectric property and ac-conductivity relaxation behavior. *Mater. Chem. Phys*. **Vol. 182**, P. 173-181; DOI: 10.1016/j.matchemphys. 2016.07.020.

29. Das, R., Gupta, K., Jana, K., **Nayak, A.**, Ghosh, U.C. (2016) Preparation, characterization and dielectric, ac conductivity with electrochemical behavior of strontium zirconate. *Adv. Mater. Lett.* **Vol. 7(8)**, P. 646-651; DOI: 10.5185/amlett.2016.6294.

30. Haldar, I., **Nayak, A**. (2017) Dielectric, ac conductivity relaxation and magnetoresistive behaviors of $BaTiO_3$-ppy nanocomposites. *J. Nanosci. Nanotech.* **Vol. 17,** P. 4658-4666**;** DOI: 10.1166/jnn.2017.13784.

31. Mukherjee, S., Pradhan, A., Maitra,T., Mukherjee, S., **Nayak, A.,** Bhunia, S. (2017) Phase selective growth of Ge nanocrystalline films by ionized cluster beam deposition technique and photo-oxidation study. *Adv. Mater. Lett.* **Vol. 8(9)**, P. 891-896. DOI: 10.5185/amlett.2017.1462.

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PAPER PRESENTED IN SEMINARS AND CONFERENCES (2006 -)

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2. **Nayak, A.** and Chetri, R. (2008) Microstructure and optical studies of non-cubic germanium nanocrystals. Condensed Matter Days-2008; held at Department of Physics, Visva-Bharati, India. August 29-31, 2008.

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4. Mukherjee, S., Pradhan, A., **Mukherjee, S., Maitra, T**., Sengupta, S., Chakrabarti, S., **Nayak, A.**, Bhunia, S. (2018) Growth and characterization of InAs sub-monolayer quantum dots with varying fractional coverage. AIP Conference Proceedings 1942, 080039. DOI:10.1063/1.5028873. View online: http://doi.org/10.1063/1.5028873.

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CREATION OF RESEARCH FACILITY AND INFRASTRUCTURE DEVELOPMENT

- DST FIST Program: I am always being actively involved for planning and procuring valuable equipment to the Department for creating infrastructure facilities. Many valuable instruments like UV-Vis-NIR spectrophotometer with reflectance measurement facility (Perkin Elmer, Lamda-750), Vacuum coating unit (Hind High vacuum Co Ltd.), FTIR spectrometer (Spectrum 2, Perkin Elmer), Electrochemical Workstation (CH Instruments) etc. have been successfully installed in the Department.
- I have taken a leading part for the creation of substantial instrumental facilities for research and teaching. A new generation sophisticated XRD (PANalytical X'PERT PRO) machine was commissioned and installed in the year 2010 under my direct supervision. This equipment was purchased from the development grant (2009-10) received from the Govt. of West Bengal.
- One HIOKI 3532-50 LCR HiTester has also been purchased from the UGC grant under my suggestions.

MAJOR DEPARTMENTAL COMMITTEES MEMBERS

- DST-FIST Program Monitoring Committee
- Purchase Committee
- Departmental Academic & PhD Committee

MAJOR UNIVERSITY COMMITTEES MEMBER & CHAIRPERSONS

- Purchase-Cum Tender Committee 2013-
- Chairman, University Admission Committee 2016-
- Member, Finance Committee
- Member, Governing Body, Presidency University
- Member, University Doctorate Committee (Sciences)
- Member, Faculty Council (Sciences)

MAJOR ADMINISTRATIVE RESPONSIBILITY (PAST)

- Head of the Department of Physics, Darjeeling Govt. College 2001-2002
- Assistant Superintendent (Government Eden Hindu Hostel) 2002-2004
- In many occasions I have been given the responsibilities normally assumed by the Head of the Department.

MAJOR ADMINISTRATIVE RESPONSIBILITY

- Professor-in-Charge, Library Services, Presidency University 2016-
  In addition to the routine work, my involvement to the ongoing program related to the modernization of library services:
- User awareness program of e-resources
- Awareness program against plagiarism using TURNITIN software
- Off campus e-resources under virtual private net-work (VPN)
- Development of Institutional Repository: Digitization and making the digital copy available to all through web for the important manuscripts and magazines of Presidency College/University has been started.
- Complete rearrangement of collections: Books are properly classified and rearranged. Initiatives have been taken to automate the library services and collection properly. Real time OPAC with the facility of vernacular language searching and actual status of the document along with the online request, email and SMS facility to the users have been started.

(Arabinda Nayak)