

## **fBiodata**

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4. **Place of birth (city/country)**: Calcutta, India.
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8. **Institute where Research was carried Out** - Raman Research Institute, Bangalore
9. **Present Academic Position** – FAScT, Professor, Dept. of Physics, University of Calcutta.
10. **Joining Date as a Lecturer** – at Narendrapur 01.09.1997 and at the University 21.01.00
11. **Title of Thesis** - Numerical and Field Theoretic Studies in Low Dimensional Condensed Matter Physics.
12. **Date of Award of Ph.D.** - 30.12.1997

### **13. Educational Qualifications:**

- (i) Passed Madhyamik Examination (10-th Std.) under W.B.B.S.E in 1983 with First division and 82.2% from Paranchak Siksha Niketan and 49th rank.
- (ii) Passed Higher Secondary Examination (10+2-th Std.) under W.B.C.H.S.E in 1985 with First division and 85.9% from Mahishadal Raj College and 26th rank.
- (iii) Passed Bachelor of Science (Hons. in Physics ) under University of Calcutta 1988 with First class (69.3%) and First division from R.K.M.R. College, Narendrapur and 6th rank.
- (iv) Passed Master of Science (Pure Physics ) under University of Calcutta in 1991 with First class and 81.6% and 2nd rank. Specialization in Solid State Physics.
- (v) Passed Post-Master of Science from Saha Institute of Nuclear Physics (Calcutta) in 1992 with First division and 76.9% and 2nd rank. Specialization in Condensed Matter Physics.

### **14. School/Workshop/Conferences Attended:**

- (1) Workshop on "Common problems in low dimensional field theory and Condensed matter systems" held in Institute Of Mathematical Sciences, (Madras, India) in February, 1993.

(2) SERC school on "Models and techniques of Statistical Physics" held in (Puri, India) organized by Institute of Physics (Bhubaneswar) in Jan-Feb, 1994.

(3) SERC school on "Liquid Crystals" held in Raman Research Institute (Bangalore, India) in May, 1994.

(4) Winter School on "Some recent developments in quantum many body systems" held in Indian Institute of Science (Bangalore, India) in Dec-Jan, 1994-95.

(5) STATPHYS-19 Conference on "Dynamics of Complex Systems" held in Satyendra Nath Bose Institute for Basic Sciences (Calcutta, India) in August, 1995.

(6) Spring College on "Disorder and Chaos in Quantum Systems" held in International Center for Theoretical Physics (Trieste, Italy) in May-June, 1996.

(7) National Symposium on "Contemporary Physics: Some Aspects" held in Presidency College, Calcutta, India in Nov 7-8, 1997.

(8) National Symposium on "Correlation in Quantum Systems" held in IIT, Kharagpur, West Bengal, India in Nov 13-18, 1998.

(9) Advanced School and Discussion meeting on "Liquid Crystals and Other Soft Materials" held in Raman Research Institute, Bangalore, India in Dec 21- 31, 1998 as a part of Golden Jubilee Celebration.

(10) Workshop on "Condensed Matter Days" held in Jadavpur University, 1999.

(11) Mini Workshop on "Application of Field Theory in Condensed Matter System" held in SNBNCBSC, Calcutta, Feb, 2000.

(12) One day Seminar in Condensed Matter Physics held in IACS, Jadavpur on 11.08.00 in honor of Late Prof. C. K. Majumdar.

(13) International Workshop on "Strongly Correlated Electron Systems" held in SINP ( Calcutta) in October 23-28, 2000 as a part of Golden Jubilee Celebration.

(14) National Level Seminar on 100 Years of Quantum Theory (29-30 Jan, 2002) held in dept. of physics of Belur Vidyamandir, Shibpur, Howrah, W. B. on the occasion of Diamond Jubilee of the college.

(15) National Seminar on Optical and Electronic properties of Novel Materials (5-7th April, 2002) held in dept. of Physics and Techno physics, Vidyasagar University, Midnapore, W. B.

(16) National Seminar on Frontier Research in Advanced Materials (27th February, 2003) held in Bengal Engineering College (Deemed University) W.B., India.

(17) National Seminar on Science and Technology of Nanomaterials (6-7 March, 2003) held in CGCRI, Jadavpur, Kolkata.

(18) National Seminar on Condensed Matter Physics `CMDAYS03' held in the department of physics, Jadavpur University from 27 Aug – 29 Aug, 2003.

(19) Taiwan-Sweden Workshop on Nanoscience and Technology and Joint Project Working Meeting held in CCMS, National Taiwan University, Taipei, Taiwan on May 17, 2004.

(20) International Symposium on Advanced Materials held in CCMS, National Taiwan University, Taipei, Taiwan on Aug 9, 2004.

(21) National Seminar on Condensed Matter Physics `CMDAYS05' held in the department of physics, Berhampur University from 29 Aug – 31 Aug, 2003.

(22) National Symposium on Recent Trends in Magnetically Correlated Physics (RTMCP) in IACS, Jadavpur, December, 2005.

(23) Attended discussion on Modelling of Nanomaterials in IACS 8-9 March, 2006.

(24) International Conference on Lasers and Nanomaterials (ICLAN) organized by department of Physics, University of Calcutta, convener, Nov 30, 2006 to Dec 2, 2006

(25) Attended the international school on “Low Dimensional Nanoscopic Physics” held at HRI, Allahabad from 28<sup>th</sup> January to February 9, 2008.

(26) Attended 19<sup>th</sup> European Conference on Diamond, Diamond Like Materials, Carbon nanotubes and Nitrides (DIAMOND 2008) held in Sitges, Spain from September 7-September 11, 2008.

(27) ICNM (International Conference on Nano Structured Materials and Nanocomposites ) 2009 held in Kottayam, Kerala April 6-8.

(28) National Seminar on Condensed Matter Physics `CMDAYS09' held in the department of physics, Jadavpur University from 26 Aug – 28 Aug, 2009.

(29) Attended ICANN 2009 held in IITG from December 9-11, 2009.

(30) Attended ICFANT2010 held in Jadavpur University from December 9-11, 2010.

- (31) Attended NCRAMT 2011, HIT, Haldia, from June 24-26, 2011.
- (32) Participated CMDAYS-2011 at Dept. of Physics, University of Guwahati from Aug 24-26, 2011.
- (33) Participated in C.K. Majumder Memorial one-day workshop in IACS (Jadavpur), November 10, 2011
- (34) Attended the 3<sup>rd</sup> IACS-APCTP conference on Physics of Novel and Emerging Materials held in IACS (Jadavpur) 15-17 November, 2011.
- (35) Attended the International Conference on “Diversity and Complexity in the realm of Statistical Physics” organized by University of Calcutta on the occasion of 60<sup>th</sup> birthday of Prof. B. K. Chkrabarti held in SINP during 14<sup>th</sup> January, 2013 to 17<sup>th</sup> January, 2013.
- (36) Attended and Participated CMDAYS2014 held in Kolkata organised by the dept. of Physics, University of Calcutta.

#### **15. Universities/Institutes/Laboratories Visited:**

- (i) Department of Physics, Bose Institute (Calcutta, India) in Feb, 1994. Seminar given on “Universal Diamagnetism of Charged Scalar Fields”.
- (ii) Department of Physical Chemistry, Indian Association for Cultivation of Science(IACS), (Calcutta, India) in Feb, 1995. Seminar given.
- (iii) Department of Physics, Condensed matter group, Jadavpur University, (Calcutta, India) in August, 1995. Seminar given.
- (iv) Department of Physical Chemistry, IACS, (Calcutta, India), August, 1995. Informal discussion with the group on “Limitation and Validity of Perturbation Theory in Many Body Physics”.
- (v) Theoretical Nuclear Physics Division, Saha Institute of Nuclear Physics (SINP), (Calcutta, India) in August, 1995. Seminar Given.
- (vi) Dept. of Physics, University of Bologna, (Bologna, Italy) in June, 1996. Seminar given on diamagnetism work.

(vii) Theory Group, CERN, Switzerland in June, 1996. Informal discussion with Dr. Per Elmfors and others.

(viii) Institute de Physique Theorique, University of Fribourg, Fribourg, Switzerland, in June, 1996. Informal discussion with Prof. Y.-C. Zhang's group on non-equilibrium interface growth problem.

(ix) ETH, Zurich, Switzerland in June, 1996. Seminar given in Prof. J. Froelich's group.

(x) LPPMH, ESPCI, Paris, France in June, 1996. Informal discussion with Prof. S. Roux on non-equilibrium interface growth problem.

(xi) Saha Institute of Nuclear Physics (SINP, Calcutta), SSMP div. Talk on "On Some non-equilibrium growth models: A pedagogical Survey" dated 26/9/96.

(xii) Institute of Mathematical Science (IMSc, Madras). Talk on "Diamagnetism of Quantum Bose System" on 24/2/97.

(xiii) Visit to University of Hyderabad (Hyderabad, India) under TPSC (Theoretical Physics Seminar Circuit) from 11/8/97 to 15/8/97. Seminar given on Spinless Bose Systems.

(xiv) Visit to Mehta Research Institute of Mathematical Sciences under TPSC Programme from October 13 to October 19, 1997. Seminar Given.

(xvi) Visit to Indian Institute of Technology (IIT), Kanpur under the same TPSC programme from October 20 to October 23, 1997. Two seminars given.

(xvii) Visit to IIT, Guwahati, Tezpur University and Dibrugarh University under the same TPSC programme from March 12 to March 19, 1998. Few seminars were given.

(xviii) Visit to Visva-Bharati University, Santiniketan from July 18 to July 22, 1998 under the same TPSC programme. One seminar was given.

(xviii) Invited talk in Mini Workshop on "Application of Field Theory in Condensed Matter System" held in SNBNCBSC, Calcutta, Feb, 2000.

(xix) Invited talk in National Seminar on Optical and Electronic properties of Novel Materials (5-7th April, 2002) held in dept. of Physics and Techno physics, Vidyasagar University, W. B.

(xx) Invited talk in National Seminar on Science and Technology of Nanomaterials (6-7 March, 2003) held in CGCRI, Jadavpur, Kolkata.

(xxi) Invited talk on Universal Diamagnetic property of spinless bosons at Dept. of Physics, Narendrapur R. K. M. R. College, 12th April, 2003.

(xxii) Invited talk on A First Principles Calculation of Optical Properties of Boron Doped Single Wall Carbon Nanotube system at IACS, Jadavpur, Kolkata, 30.12.2004.

(xxiii) Invited talk on Ab-initio study of optical conductivity of  $B_xC_y$  nanocomposite system at Berhampur University, Orissa, 30.08.2005. ( CMDAYS05).

(xxiv) Invited talk on Mott conductivity of amorphous material- A generalized Formulation at IACS (Jadavpur),RTMCP-2005 on 23.12.2005 ( Krishnan's 107<sup>th</sup> birthday celebration).

(xxv) Invited talk on `Doping effects of B and N on electronic and optical properties of single wall carbon nanotubes' at Narsingha Dutta College for UGC sponsored national level seminar on ``Nano Science and its effect on society" held on 28<sup>th</sup> -29<sup>th</sup> March, 2008.

(xxvi) Visited the group of Prof. Pere Rours of University of Girona, Spain , September 12-September 15, 2008. Seminar given on defect physics of ZnO and carbon nanotubes.

(xxvii) Invited talk on "Fundamentals of Solar cells and its technology" at Vivekananda Mission Mahavidyalaya, for UGS Sponsored State Level Seminar on "Future Trend in Solar Based Systems" on 16.01.2009.

(xxviii) Invited Talk on "A density functional theory of optical properties of B and N alloyed Single Wall Carbon Nanotubes" ICNM 2009, Kottayam, Kerala, April 6-8.

(xxix) Invited Talk on `Magnetic Field Induced Hopping Conduction in Pseudo-gap Interacting System" held in CMDAYS 09 in the Dept. of Physics, Jadavpur University, August 26-28.

(xxx) Invited Talk "ICANN" held in IIT Guwahati, December 9-11, 2009 on `A comparative study of optical properties of  $C_3N$  and  $CN_3$  systems through Density Functional Theory (DFT)".

(xxxi) Visited the department of Physics of North Bengal University (NBU) under UGC scheme of Visiting Professor from 20<sup>th</sup> May to 30<sup>th</sup> May, 2010 and taught advanced condensed matter physics course to post graduate students.

(xxxii) Visited CCMS, NTU, Taiwan from October 17, 2010 to October 30,2010 and delivered a presentation on "Defect Dynamics of ZnO and optical properties of B,N alloyed single wall carbon nanotubes(SWCNT)".

(xxxiii) Invited talk in ICFANT2010 on "Anisotropic signature of optical properties of  $BC_3$  and  $B_3C$  systems by Density Functional Theory (DFT)".

(xxxiv) Invited Talk at QPAM11 in the department of Physics, Vidyasagar University 24.03.2011 on "Universal diamagnetism of spinless Bose system".

(xxxv) Invited talk in NCRAMTT2011 (25.06.2011) on “Anisotropic signature of optical conductivity and refractive index of  $BC_3$  and  $B_3C$  systems by Density Functional Theory (DFT)”.

(xxxvi) Invited talk in CMDAYS-2011 at Dept. of Physics, University of Guwahati from Aug 24-26, 2011. Seminar on “Effect of insertion of single Li atom on the optical properties of single walled carbon nanotubes”

(xxxvii) Visit to Tezpur University from September 5- 6, 2011 as a member of UGC nominated fellow for JRF selection. Seminar given on Generalized Mott Conductivity of Pseudo-gap Amorphous System.

(xxxviii) Visit to Tezpur University from October 24-25,2011 for NET Classes to Post-graduate students of Dept. of Physics.

(xxxix) Invited talk in UGC sponsored National Seminar on “Photonics and Nanosciences” held in Dept. of Physics, Garhbeta College during 20-21 December, 2011. Title of the seminar was “ Intriguing features of nanoscience and nanotechnology”.

(xxxx) Invited talk in UGC sponsored National Level Seminar on “History of Physics” held in Dept. of Physics, Netaji Mahavidyalay, Arambagh, Hooghly during 6-7 January, 2012. Title of the seminar was “ Intriguing features of Nanoscience from ZnO and Single Wall Carbon Nanotubes”.

(xxxxi) Invited talk in AICTE sponsored National Level Seminar on “Synthesis, Characterization and Simulation in Nanoscience and Nanotechnology (NANOSIM)” held in JIS College of Engineering, Kalyani, Nadia, West Bengal during 24-25 February, 2012. Title of the seminar was “ Electronic and Optical properties of B and N-doped Single Wall Carbon Nanotubes”.

(xxxxii) Visited CCMS, NTU, Taiwan from May 12, 2012 to May 19,2012 and delivered a presentation on “Chemical and optical properties of B, N alloyed single-walled carbon nanotubes (SWCNT)”.

(xxxxiii) Invited talk in Golden Jubilee Celebration of Ramakrishna Mission Vivekananda Centenary College, Rahara on 10<sup>th</sup> January, 2013. Title of the seminar was “Intriguing features of Nanoscience from ZnO and Single Wall Carbon Nanotubes”

(xxxxiv) Invited talk in International Conference on “Diversity and Complexity in the realm of Statistical Physics” organized by University of Calcutta on the occasion of 60<sup>th</sup> birthday of Prof. B. K. Chkrabarti held in SINP during 14<sup>th</sup> January, 2013 to 17<sup>th</sup> January, 2013. Title of the seminar was “ Scaling Analysis of Rough Interface”.

(xxxxv) Invited talk in 3<sup>rd</sup> National Conference On Engineering Education in the New Century (E2NC-2013) Supreme Knowledge Foundation Group of Institution, Mankundu on 16<sup>th</sup> February, 2013. Title of the seminar was “Effect of Chemical doping of Boron and Nitrogen on the Electronic, Optical and Electrochemical properties of Carbon Nanotubes”.

(xxxxvi) Invited talk in CMDAYS-2013 held in Rourkela, Orissa during 27-28 August, 2013. Title of the seminar was “Effect of Chemical doping of Boron and Nitrogen on the Electronic, Optical and Electrochemical properties of Carbon Nanotubes”.

(xxxxvii) Invited Talk and Chairing a session ICNT-2013 held in Haldia Institute of Technology, 25-26 th October, 2013. Title of the seminar was “Effect of Chemical doping of Boron and Nitrogen on the Electronic, Optical and Electrochemical properties of Carbon Nanotubes”.

(xxxxviii) Chaired a session in GATI-2014, a Indo-UK Scientific Seminar from Graphene Analogues to Topological Insulators held in Vedic Village, Kolkata during January 27-29, 2014.

( xxxix) Invited Talk at CTMat2014 at VECC during 19-21 Nov, 2014.

(xxxxx) Invited Talk at Bangabasi Morning College, Dept of Mathematics, Septmeber 11-12, 2015. UGC sponsored seminar on “Mathematics and its impact on Science”. Topic: Dimensional Analysis and Renormalization.

(xxxxxi) Invited Talk at FMTT 2015, Kolkata Oct 28-30, 2015.

**16. Visiting Researcher Position:** From Nov 10, 2003 to Dec 19, 2004 at the Center for Condensed Matter Sciences of National Taiwan University, Taiwan on study leave from University of Calcutta, W.B., India.

I was involved in the following two theoretical projects in condensed matter group of Prof. Li - Chyong Chen and Prof. K. H. Chen. The two projects are described below.

(a) Numerical ab-initio calculation on carbon nano tube

This project is of numerical computation nature using CASTEP code. The ab initio calculation in material science is important from two points of view. Firstly, it can explain the experimental observation of some physical properties as well as the most likely structure of the materials from total energy calculations. Secondly, it can also predict some of the interesting features associated with the band structure that may be of interest to experimentalist for verification. The ab initio calculation is based on density functional theory with appropriate exchange correlation functions.



Studies on Carbon nanotubes are interesting from a fundamental research point of view. They can be of different nature - metal or semiconductor depending on the helicity. I am involved in the electronic band structure and density of states (DOS) calculation of single wall carbon nanotubes (SWCN) with substitutional doping of impurity atoms such as Li, K, B and N. It has been noticed that the alkali doped carbon nanotubes have high hydrogen storage capacities. The doped carbon tube in contrast to intrinsic or pure semiconductor has the capability of detecting a wide range of gas molecules. The sensitivity of these devices can be controlled by the doping level of impurity atoms in a nanotube. Therefore, it is interesting to know how the various doping concentration affect the electronic structure of the carbon nanotube. The preliminary results do show some change in band structure and density of states in metallic and semiconductor nanotubes. These results might have some importance over the usual tight binding calculations. In future, I would like to investigate some of the intriguing optical properties of these doped nanotubes. Again experiments indicate that different metals have different binding signature on the nanotube surface corresponding to different coating phenomena. Even the interaction of SWCN with transition metal is also interesting from the magnetization point of view as well as from the electronic structure. This study might be helpful to know the key role played by the transition metal atoms (Fe, Co and Ni) in the production of SWCN. The interactions of all these elements are different from the graphene sheet in terms of binding energy, binding character and charge transfer. The curvature effect in nanotubes and the interaction between the tubes might also play an important factor in characterizing the electronic band structure. Local Density of states (LDOS) thus computed can be directly compared with normalized differential conductance study of the SWCN in Scanning Tunneling Spectroscopy (STS) measurements.

In contrast to  $C_{60}$  (finite) molecule, the quasi-one dimensional nature and confined geometry of the carbon nanotubes provide interesting peculiar physical, chemical and mechanical properties with respect to chirality and a wide range of diameter.

This project is of numerical computation nature using CASTEP code. A *first principles calculation* uses the correct Hamiltonian and does not use experimental data other than values of the fundamental physical constants. Here, we use C-C bond length (0.142 nm) as the only parameter in the calculation.

I am involved in the calculation of the optical properties of single wall carbon nanotubes (SWCN) with substitutional doping of impurity atoms such as Li, B and N. It has been noticed that the alkali doped carbon nanotubes have high hydrogen storage capacities. The doped carbon tube in contrast to intrinsic or pure semiconductor has the capability of detecting a wide range of gas molecules. Even the B doped system can have enhanced field emission. The doping level of impurity atoms in a nanotube can control the sensitivity of these devices. Therefore, it is interesting to know how the various doping concentration affect the electronic structure as well the various optical properties of the carbon nanotubes. We would like to discuss the first the effect of Li doping on various carbon nanotube and then move on to B doping. First we present a comparison of the various parameters with graphite because the CNTs are made of graphene layers. In all these computations, we use GGA/norm-conserving spin un-polarized pseudo-potential and 6 kpoints and 470 eV as the cut-off energy.

(i) Li doping:

We calculate the imaginary part of the dielectric constant in the dipole approximation in the long wavelength limit as

$$\varepsilon_2(q \rightarrow 0, \vec{u}, \hbar \omega) = \frac{2e^2\pi}{\Omega \varepsilon_0} \sum_{k,v,c} |\langle \psi_k^c | \vec{u} \cdot \vec{r} | \psi_k^v \rangle|^2 \delta(E_k^c - E_k^v - E)$$

Once this imaginary part is computed, we can get the real part via Kramers-Kronig relation and all other optical properties such as reflectivity; absorption, refractive indexes and the Loss function can be obtained easily. The Loss function  $\text{Im}\left(\frac{-1}{\varepsilon(\omega)}\right)$  can be measured by the Electron Energy Loss Spectroscopy (EELS) and the peak position gives hint towards the collective excitations of the system. Below we present the static value of the dielectric constant computed at 0.0150 Hz for pure and doped cases of various carbon nanotubes for parallel polarization.

We notice that both real and imaginary part of the dielectric function of the doped case is *higher* than the corresponding pure one. This is also seen in perpendicular polarization as well as for unpolarized light with incidence (1,0,0) although the corresponding values are different. This implies that the static susceptibilities in Li doped case are larger corresponding the pure case. This fact is independent of the nature of carbon nanotube.

(ii) Boron Doping: We here study the variation of optical properties with Boron doping. First we show the typical super cell geometry of the pure (8,0) CNT and BC3 system. The super cell is made of 3d Triclinic crystal symmetry with  $\alpha=\beta=90^\circ, \gamma=120^\circ$  and  $a=9.40\text{\AA}, b=9.50\text{\AA}, c=4.21\text{\AA}$ . From the absorption spectra of these doped systems, we show below the variation of maximum absorption coefficient with boron doping in case of perpendicular polarization. The similar trend behavior has also been noticed in parallel polarization as well as un-polarized light with incidence direction (1.0,0.0,0.0).

The peak position of the Loss function in parallel polarization also varies smoothly with the Boron doping concentration as shown below. Similar trend has also been noticed for unpolarized light. The non-linear variation of plasma frequency with Boron doping indicates explicitly the dependence of collective excitation with doping. The other optical properties such as reflectivity, refractive index have been calculated with Boron doping concentration. Though the static reflectivity in all cases show a unique minimum, however the maximum reflectivity variation in perpendicular polarization is linear in contrast to non-linear behavior with doping in parallel and un-polarized case. All these optical study, however, share one common feature – strong anisotropic behavior corresponding to nature of electromagnetic field. The optical conductivity is studied from the dielectric constant with zero DC conductivity and 0.5 eV Drude damping. A typical polynomial fit suggests the existence of a unique minimum value of  $\sigma_{\max}(\omega)$  at a particular Boron doping concentration in all three cases. All these theoretical predicted results might shed some light in an optical experiment involving (8,0) B-doped SWCNT. I have also done some numerical calculation of Nitrogen doping in the (8,0) SWCNT. The preliminary results on this system show some remarkable deviation in the optical properties from the above B doping systems.

## (b) Quantum Confinement effect on nanowires

The small size of the nano structures result a spatial confinement of the carrier wave function. This is termed as the Quantum confinement. With decreasing size, the effective band gap increases and the relevant absorption and emission spectra shift to bluer wavelengths. The cathodoluminescence (CL) peak energies from the nanowire or nanorod are higher than the bulk material GaN. The experimental results show a size dependent peak position. It is evident that confinement energy is stronger for small diameter nanowire and most of the situations scale as inverse of the square of the diameter of the wire. This can be understood from the effective mass approximation (EMA) as well as from the uncertainty principle. Recently, in GaN nanowire, the peak shift in CL spectra has been noticed even for large diameter nanowire. The shift in energy scales differently with the size of the nanowire as predicted by the EMA. All these nanowires have diameter much larger than the effective Bohr radius of GaN. The band gap variation in these system with size also play an important role in shifting the position of the peak of CL. It will be interesting to do a simple model calculation to explain this feature of the nanowire observed in the experiments and also to find a general formula valid for whole range of size of GaN nanowire. The interaction of nanowires and its strain energy should be taken into account in the model calculation.

## 17. Research Plan for Next 5 years:

I am basically interested in condensed matter physics. My research interest in three directions:

- I. Study of interface motion in disordered medium
- II. Strongly correlated electron systems
- III. Study of oxidation kinetics of nano-structured amorphous silicon

### **I. Study of interface motion in disordered medium:**

This project has both numerical/analytical as well as experimental aspects. Suppose one places a filter paper in ink solution, then one find that the ink rises through the paper. After a while the flow stops and the ink leaves a jagged boundary on the paper. Though the precise form of the boundary is different each time one does the experiment, however, it is seen that the statistical features of the jagged boundary are reasonably robust and amenable to study. This is a simple 'table-top' experiment. This experiment mimics diffusion in 2D random porous medium and is of importance in thin layer chromatography.

The study concerns the static as well as the dynamic properties of the interface formed. We would like to study the various factors in shaping the roughness of the interface. The roughness process is studied by scaling analysis.

The exponents obtained under this scaling are independent of 'many' details of the system. We are interested to know the essential factors on which the exponents do depend. The next step is to simulate a simple cellular automata model from the first principles which can capture the essence of the experiments. Finally, one hopes to write down a simple stochastic partial differential equation in height ( $h$ ) variable and then to try for a solution.

## **II. Strongly correlated electron systems:**

Low dimensional condensed matter systems are of great importance because of their technological application as well as their involved theoretical calculations.

Two dimensional tight binding model with on site disorder potential is invoked in such a situation to study some of the interesting features associated with 2D disordered systems in an external magnetic field. We would like to employ Generalized Inverse Participation Ratio (GIPR) to study these electronic states. The exponent relating to this GIPR dependence on the system size varies with the strength of the disorder potential. We are interested to study this variation numerically as well as analytically (if possible). We also would like to investigate the difference between the continuum and discrete model in calculating the conductivity and susceptibility of this 2D system.

Chern Simons Landau Ginzburg (CSLG) theory has been one of the key to understand the long wavelength behavior of Fractional Quantum Hall Effect (FQHE). I am interested to investigate in greater detail some of the issues associated with this low dimensional field theory. These Chern Simons bosons do obey the diamagnetic inequality. An explanation of Hall Plateaus is sought in the Meissner effect of these composite bosons. Understanding of the behavior of these composite bosons might help in explaining the width of the plateaus seen in the experiment.

Mott conductivity relation for amorphous material in any arbitrary dimension with generalized Coulomb gap has been investigated along with Prof. Joaquim Fort of University of Girona, Spain. The density of states in this situation has a soft gap at the Fermi surface. This is of interest to see how the effect of interaction changes the Mott conductivity exponent in the non-interacting case. The effect of high field has also been investigated in this framework. Recently, I have taken up a project to study the effect of magnetic field (strong as well as weak) on this Variable Range Hopping (VRH) model for the amorphous system.

Fluctuation conductivity and Paramagnetic Meissner effect are two important features associated with High Temperature Superconductivity. I am interested to study their behavior with temperature through a generalized Landau-Ginzburg theory.

## **III. Study of oxidation kinetics of Nano-structured amorphous silicon:**

This is a collaborative UGC sponsored minor project No. F.PSW-027/01-01 (ERO) with Dr. Debabrata Das of Dept. of Physics, R. K. M. R. College, Kolkata-103 as the principal investigator.

In this project we are trying to investigate the oxidation behavior and oxidation kinetics of amorphous Si and SiC nanoparticles.

The main aim is to find the role of hydrogen in the oxidation process. These nanoparticles are deposited by radio-frequency plasma enhanced vapor deposition ( rf-PECVD). We will use IR, XRD, TEM and DSC as tool for this investigation. At present, we are using XRD to find any structural change in the samples annealed at different temperatures.

#### **18. Teaching Experience:**

I am teaching at present General Solid State Physics, Advanced Material Physics, Collective Phenomena in Solid State Physics and Condensed Matter Physics to M.Sc. Students. I am also looking after the experiments in condensed matter laboratory.

Often I take some surprise Quiz to test the conception of the subjects developed in the students. Problem sets were also given to judge their concepts as well as to overcome and to do better result in the examination.

I offered an informal graduate level course on 'Quantum Many Body Theory' to Prof. Indrani Bose's group (Bose Institute, 93/1, A. P. C. Roy Road, Cal- 9). Four students attended the course and few sets of problem on the subject were given.

I had taught Advanced Quantum Mechanics and Statistical Mechanics to M. Sc. students of B. E. College (Deemed University), Shibpur, Howrah as a guest lecturer.

#### **19. Present Research Project:**

*(A) Low Dimensional Strongly Correlated Electron Systems*

*(B) Defect Dynamics Studies of Annealed ZnO by PAS (Project with IUAC, New Delhi).*

*(C) Evolution of structural and opto-electronic properties of silicon nitride and Silicon Carbide nanoparticles with oxidation and investigation of their oxidation mechanism. Joint UGC Minor project with Dr. Debabarta Das of R.K.M.R. College, Narendrapur as PI starting from March 2005-March 2007.*

#### **20. Community Service For Popularizing Science:**

I have given lectures in National Science Camp, Digha Science Center (W.B., India) in 2000 and 2001 to motivate the young talented students for pursuing research career in Physics. In 2003, I have been invited to give some introductory lectures to high school students to illustrate some basic principles of science. I have also been involved in Physics teaching in undergraduate as well as postgraduate courses in Narendrapur R. K. M. R. College, Narendrapur, Kolkata, W.B.

## **21. Membership of Professional Bodies/Editorship of Journals:**

(i) Nominated as one of the members of Indian Physical Society for 2003-2004, 2004-2005 and 2008-2009.

(ii) One of the members of the editorial board of Indian Journal of Physics for 2003-2004.

(iii) Nominated as one of the board members of the expert committee for NTSE-Class-VIII (Kolkata Board), 2007, 2008, 2009, 2010.

(iv) One of the members of the expert committee of URF selection in IUAC, New Delhi from 2008-2011.

(v) External Expert of DST sponsored project entitled “ Dielectric relaxation complex perovskite oxides” under the guidance of Prof. T. P. Sinha, Dept. of Physics, Bose Institute.

(vi) External Examiner of Viva Voce of Ph.D. degree of Jadavpur University of the thesis of Mr. Pradip Kumar Jana entitled “Dielectric and electrical property of some doped transitional metal oxides: Giant Permittivity Materials” under Prof. B. K. Chaudhuri of IACS.

(vii) UGC visiting Fellow for North Bengal University during 20<sup>th</sup> May 2010 to 29<sup>th</sup> May 2010. Some topics of Condensed matter Physics were taught to Final year M. Sc. Students.

(viii) Subject expert for SSC (School Service Commission) 2003, 2009, 2010, 2011.

(ix) External Examiner of Viva Voce of Ph.D. degree of Jadavpur University of the thesis of Smt. Amrita Mukherjee entitled “Investigation of Dielectric and electro-optical property of ferro and anti-ferroelectric liquid crystals” under Prof. B. K. Chaudhuri of IACS in 2010.

(x) External Examiner of Viva Voce of Ph.D. degree of Jadavpur University of the thesis of Sri Suman Sinha entitled “Monte Carlo simulation in some continuous lattice spin models” under Prof. S. K. Roy of Department of Physics, Jadavpur University in 2010.

(xi) External Examiner of Viva Voce of Ph.D. degree of Jadavpur University of the thesis of Sri Soyma Prasad Mukherjee entitled “Study of Unconventional Superconductivity” under Prof. S. S. Mandal of Department of Theoretical Physics, IACS, Jadavpur in 2010.

(xii) Subject expert in Eighteenth West Bengal State Science and Technology Congress held in Narendrapur Ramakrishna Mission Residential College from 28<sup>th</sup> February-1<sup>st</sup> March, 2011.

(xiii) External Examiner of Viva Voce of Ph.D. degree of the thesis of Sri Deep Talukdar entitled “” under Prof. K. K. Bardhan of SINP, University of Calcutta in 2012.

(xiv) External Examiner of Viva Voce of Ph.D. degree of Jadavpur University of the thesis of Mrs. entitled “” under Prof. J. K. Bhattacharyya of SNBNCBSC, 2013.

## 22. Any Award/special prize:

Bronze medal was awarded for poster presentation in ICON 2005, Taipei, Taiwan.

Tarapada Maity Smriti Puraskar 2014- Popularization of Science Education in Bengal from an NGO in East Medinipur.

Elected **Fellow** of West Bengal Academy of Science and Technology (WAST), 2015 in the Physical Science Category.

Distinguished Scientist in Physics - 2017 Award from Venus International Research Award (VIRA), Chennai, India.

Vidyasgar Smriti Puraskar 2020 in Science Education in Bengal from an NGO in East Medinipur.

## 23. Reviewer of Journals:

Indian Journal of Physics (IJP), Asian Journal of Physics (AJP), Solar Energy Materials and Solar Cells (SOLMAT) (Elsevier), Journal of Experimental Nanoscience (U.K.), Materials of Chemistry and Physics (Elsevier), Journal of Applied Physics (AIP), Nanoscience and Nanotechnology Letter (Japan), Journal of Modern Physics (Science Research Review), Diamond and Related Matter (Elsevier), Material Research Bulletin (Elsevier), Journal of Statistical Mechanics: Theory and Experiment (IOP), Material Science in Semiconductor Processing (Elsevier), Journal of Chemistry (Open access Journal), Small (Wiley-VCH), Indian Journal of Applied Physics, Ingeniería y Ciencia journal (Spain), Scripta Materialia, Journal of the American Ceramic Society, Journal of Physics and Chemistry, Physical Chemistry Chemical Physics, RSC Advances, Carbon, Euro Phys. Journal B, Physica B, Physica E, Prog. Mat. Science ( Elsevier), Journal of Physics and Chemistry of Solids (Elsevier). Nano Letters ( ACS Nano), Material Science and Engineering B ( Elsevier), Applied Surface Science ( Elsevier), Nanoscale (RSC Journal), Advanced Functional Material (Wiley-VCH), Journal of Molecular Liquids (Elsevier), Nanoscale Research Letters, Modern Physics Letter B (World Scientific, Singapore), Solid State Communications (Elsevier), Current Applied Physics (Elsevier), Crystals, Journal of Nanoscience and Nanotechnology (JNN Korea, ASP), Journal of Material Science ( Elsevier)

## 24. List of Publications:

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- (2) P. B. Sunil Kumar and **D. Jana**, Imbibition: An Example of nonconserved cellular automaton, cond-mat/9509047.
- (3) **D. Jana**, Charged Scalar Field in an external magnetic field: Renormalization and Universal Diamagnetism, Nucl. Phys. B, **473[FS]**, No. 3, 659-684 (1996).
- (4) **D. Jana**, Charged Scalar Field in an external magnetic field: Renormalization and Universal Diamagnetism,(Erratum), Nucl. Phys. B, **485[FS]**, No. 3, 747-749(1996).
- (5) **D. Jana**, On a simple yet interesting experiment in Complex System, Physics Teacher, **40**, No. 4, 161 (1998).
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- (8) **D. Jana**, Kohn's Theorem: An Example of charge and mass renormalization in condensed matter physics, Physics Education, **18**, No. 3, 177 (2001).
- (9) **D. Jana**. Universal Diamagnetism: Exact Results and Applications, Int. Journal of Modern Physics B, **15** No. 19-20, 2811 (2001).
- (10) **D. Jana**, A scaling Analysis of Law of Corresponding States, Physics Education, **19**, No. 3, 167 (2002).
- (11) D. Das, K. Nandi and **D. Jana**, Nanostructures: Physics and Technology, Physics Education, **19**, No. 3, 155 ( 2002 ).
- (12) **D. Jana**, Dielectric Constant of water vapor and water, Physics Education, October-December, **19**, No.3, 247 (2002).
- (13) **D. Jana**, On a Novel Regularization Scheme, Fizika B (Zagreb) **11**, 63-72 (2002).
- (14) **D. Jana**, Applicability of Perturbation theory to Many Body Physics, Physics Teacher, **44**, 21 (2002).
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- (22) **D. Jana** and J. fort, On Mott conductivity exponents of Pseudo-gap amorphous systems, in 'Frontiers on Condensed Matter Physics Research' edited by John V. Chang (Nova Science Publishers, NY, USA (2006)) pp 111-128.
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- (111) Saptarshi Pal , Narendar Gogurla , Avishek Das , Shib Shankar Singha , Tamita Rakshit , Pravin Kumar, Dinakar Kanjilal , Achintya Singha, Sanatan Chattopadhyay, Debnarayan Jana, **Anindya Sarkar**, Clustered vacancies in ZnO: Chemical aspects and consequences on physical properties, J. Phys. D: Appl. Phys, **51**, 105107 (2018).
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- (113) Debnarayan Jana, A Toy Model of Two Dimensional Polarizable Material, Physics Education, Volume 34, No. 2. April-June (2018).



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- (115) N. Dhar and **Debnarayan Jana**, A DFT perspective analysis of optical properties of defected germanene mono-layer, Phys. Sciences Review 2018; 20170164
- (116) Arka Bandyopadhyay and **Debnarayan Jana**, A detailed first-principles investigation of optical properties of monolayer T-graphene sheet and nanoribbon, JSM Nanotechnology & Nanomedicine, **5**, 1057 (2017).
- (117) Suchanda Mondal, **Kajari Dutta**, Shibsankar Dutta, Debnarayan Jana, Adam Kelly, and **Sukanta De**, Highly Efficient Flexible White light Photodetector based on BiFeO<sub>3</sub> , ACS Applied Nanomaterials, **1(2)**, 625 (2018)
- (118) Deblina Chakraborty, Animesh Dey, **Upendranath Nandi**, D. Jana, Papri Dasgupta, Asok Poddar, Effect of Annealing Temperature on the Structural and the Electrical Transport Properties of La<sub>2</sub>NiMnO<sub>6</sub> Nanoparticles, Physica Status Solidi B, 1700436 (2017). DOI : 10.1002/pssb.201700436
- (119) N. Dhar and **Debnarayan Jana** Magnetic and optical properties of carbon and silicon decorated free standing buckled germanene: A DFT approach, J. Phys. Chem Solid, **115**, 332 (2018).
- (120) Apu Mondal, S Pal, Anindya Sarkar, T. S. Bhattacharya, A. Das, N. Gogurla, S. K. Ray, Pravin Kumar, D. Kanjilal, K. D. Devi, Achintya Singha, Sanatan Chattopadhyay and **Debnarayan Jana**, Raman spectroscopic analysis on Li, N and (Li,N) implanted ZnO, Mat. Science Semiconductor Processing, **80**, 111 (2018).
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- (122) Debnarayan Jana, 2D Materials: Future and Perspectives, J. Nanomed Res, **7(1)**, 00169 (2018).
- (123) Debnarayan Jana, Nanosystem and Magnetism, J. Nanomed Res, **7(3)**, 00189 (2018).
- (124) Arka Bandyopadhyay, Shashikana Paria and **Debnarayan Jana**, Tetragonal graphene nanodot as carbon monoxide gas sensor and current rectification device, Jour. Phys. Chem. Solids **123** 172 (2018).
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(127) Gargi Chakraborti (Banerjee), Arka Bandyopadhyay, and **Debnarayan Jana**, Effect and characterization of Stone-Wales defects on graphene quantum dot: a first-principles study, Condensed Matter, **3**, 50 (2018).

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- (137) Supriya Ghoshal, Homnath Luitel, Sujoy K. Mandal, Dirtha Sanyal, and **D. Jana**, Half metallic ferromagnetic and optical properties of Ruthenium-doped Zinc-blend ZnS: A first principles study, *Journal of Physics and Chemistry of Solid*, **136**, 109175 (2019).
- (138) Sujoy Datta, **Prashant Singh**, Debnarayan Jana, Chhanda B Chaudhuri, Manoj K Harbol and Abhijit Mookerjee, Exploring the role of electronic structure on the photocatalytic behavior of carbon-nitride ( $C_3N_4$ ) polymorphs, *Carbon*, **168**, 125 (2020).
- (139) Debaprem Bhattacharya and **D. Jana**, First-principles calculation of the electronic and optical properties of a new two-dimensional carbon allotrope: tetra-penta-octagonal graphene, *Physical Chemistry Chemical Physics*, **21**, 24758 (2019).
- (140) Arka Bandyopadhyay, Subhadip Nath, Sujoy Datta, Md. Mohi Uddin and **D. Jana** The topology and robustness of two Dirac cones in S-graphene: A tight binding approach *Scientific Reports*, **10**, 2502 (2020).
- (141) Subhadip Nath, Arka Bandyopadhyay, Sujoy Datta, Md. Mohi Uddin and **D. Jana** Electronic and optical properties of non-hexagonal Dirac material S-graphene sheet and nanoribbons, *Physica E*, **120** 114087 (2020).
- (142) Debaprem Bhattacharya and **D. Jana**, Twin graphene: A new two-dimensional semiconducting carbon allotrope, *Physical Chemistry Chemical Physics*, **22**, 10286 (2020).
- (143) Arka Bandyopadhyay and D. Jana, A review on the role of tetra-rings in the graphene systems and their possible applications, *Reports on Progress in Physics*, **83**, 056501 (2020).
- (144) Sujoy Datta and **D. Jana**, Electronic structural critique of interesting thermal and optical properties of  $C_{17}$  Ge germagraphene, *Physical Chemistry Chemical Physics*, **22**, 8606 (2020).
- (145) Arka Bandyopadhyay and **D. Jana**, Dirac Materials in a Matrix Way, *Universal Journal of Material Science*, (Horizon Research Publication (HRPUB), USA), **8, No. 2**, 32-44 (2020).
- (146) Debnarayan Jana, Spin Inequality for Energy Computation of Heisenberg Spin Hamiltonian, *Physics Education*, volume **XX**, No. 1, YY (2020).
- (147) Debaprem Bhattacharya and **D. Jana**, TPDH-graphene: a new metallic carbon allotrope (Submitted to *Physica E*, 2020).
- (148) Supriya Ghoshal, Arka Bandyopadhyay and **D. Jana** Field induced efficient band tuning and optical and thermoelectric responses in tetragonal germanene: A theoretical approach ( To appear in *Physical Chemistry Chemical Physics*, (2020).
- (149) Debnarayan Jana, BCS Theory in (2×2) Matrix way, (Submitted to *Physics Education* 2020).

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(151) Niladri S. Mondal, **Subhadip Nath**, Debnarayan Jana and Nanda K Ghosh  
Band engineering of non-hexagonal 2D tetragonal-Silicene sheet and nanoribbons: A theoretical approach ( Submitted to Jour. Phys. Chem. Solid, 2020)

(152) Sumona Sinha, Supriya Ghoshal and **D. Jana**, Tuning the Electronic and Optical Properties of Graphene by Adsorption of PTCDI Molecule (Submitted to Physica E, 2020).

(153) Subhadip Nath, Arka Bandyopadhyay, Sabyasachi Sen, and **Debnarayan Jana**, First Principles Investigation of Structural, Electronic and Optical Properties of Synthesized Radiaannulene Oligomers for 6,6,12-Graphyne ( Submitted to Journal of Chemical Physics, 2020).

(154) Arka, Bandyopadhyay, Arnab Majumdar, Suman Chowdhury, Rajeev Ahuja, and **Debnarayan Jana**, 8-16-4 Graphyne: Rare Square Lattice Two-Dimensional Material with Double Dirac Cones and Zak Index (Submitted to The Journal of Physical Chemistry Letter, 2020).

(155) Sujoy Datta and **Debnarayan Jana** , Semiconductor Physics: A Density Functional Journey, Invited Book Chapter for the volume "**Advanced Semiconductor**" ( Submitted to Springer ebook series, 2020)

(156) Sujoy Kumar Mondal, Supriya Ghoshal, Devdas Karmakar and **Debnarayan Jana**, Ru doped ZnS as an enhanced visible-light driven photocatalyst, Invited Book Chapter for the volume "**Advanced Semiconductor**" ( Submitted to Springer ebook series, 2020)

(157) Sumona Sinha, Susmita Jana and **Debnarayan Jana**, Overview of Modern Emerging Semiconductors, Invited Book Chapter for the volume "**Advanced Semiconductor**" ( Submitted to Springer ebook series, 2020).

### 23. Projects Supervised during 2000-2002.

I. *Study of Thermodynamics in 2D Quantum Dot in a Homogeneous Magnetic Field*  
by **Mr. Srijan Kumar Saha**.

II. *Quantum Mechanics of 2D Electron Gas in Strong Magnetic Field* by **Ms. Moumita Maiti**.

### 25. Projects Supervised during 2002-2003:

I. *Study of Bound State Systems in Quantum Mechanics* by **Miss Deblina Banerjee**.

II. *Bose-Einstein Condensation* by **Mr. Dhritiman Gupta**.

III. *Experimental Study of F-center density in KCl crystals* by **Mr. Sukumar Bera**. This project was done to fulfill the requirement for obtaining M. Sc. degree in Applied Physics from B. E. College, Howrah.

IV. *Study of Thermodynamic Properties in One Dimensional Ising model* by **Ashis Maity**. This project is also a part of M. Sc. degree in Applied Physics from B. E. College, Howrah.

#### 26. **Projects Supervised during 2003:**

I. *X-ray Diffraction study of Cu and Al crystals* by Ms. **Mahua Pariksha**. This project was done as a part of M. Sc. Degree in Applied Physics from B. E. College, Howrah.

II. *Study of Cooper Pair problem in Superconductivity* by Ms. **Soma Chatterjee**. This project was also done as a part of M. Sc. Degree in Applied Physics from B. E. College, Howrah.

#### 27. **Projects Supervised during 2008:**

I. *Study of crystal structure determination of unknown materials using Powder X software* by Ms. **Moumita Dey**.

II. *Resistivity Measurement by four probe method and determination of critical temperature of a high temperature superconductor BSCCO-2212* by Ms. **Dyuti Bhattacharya**. This project was done in 4<sup>th</sup> Semester as a part of M. Sc. Degree in Physics from University of Calcutta.

III. *Study of the variation of resistivity with temperature for a high  $T_C$  superconductor  $(Bi-Pb)_2Sr_2CaCu_2O_{8+\delta}$  and determination of the critical transition temperature* by Ms. **Indrani Chakrabarti**. This project was done in 4<sup>th</sup> Semester as a part of M. Sc. Degree in Physics from University of Calcutta.

IV. *Measuring of resistivity by four probe method and determination of the critical transition temperature of a high temperature superconductor  $(Bi-Pb)$ -2212* Mr. **Sreemanta Mitra**. This project was done in 4<sup>th</sup> Semester as a part of M. Sc. Degree in Physics from University of Calcutta

#### 28. **Projects Supervised during 2009:**

Miss Suchetana Sadhukhan of Vidyasagar College did a project on 'Study on various potentials of Quantum Mechanics and Statistical Thermodynamics' during August, 2008 to January, 2009.

### **29. Projects Supervised during 2010:**

I. *The effect of Ball milling and Annealing on structural and optical properties of TiO<sub>2</sub>* by **Ms. Urmi Chakrabarty, Mr. Sushovan Paul, Mr. Saptarshi Pal and Mr. Manas Bag**. This project was done in 4<sup>th</sup> Semester as a part of M. Sc. Degree in Physics from University of Calcutta.

II. *Study of the nature of interface growth and scaling analysis of roughness of the surface* by **Mr. Chinmay Mandal**. This project was done in 4<sup>th</sup> Semester as a part of M. Sc. Degree in Physics from University of Calcutta.

### **30. Summer Projects Supervised during 2010:**

I. *Ultra-cold Fermi Gas in trapped geometry: Sommerfeld's expansion* by **Rajkumar Manna of IIT, Madras** in collaboration with Dr. Shyamal Biswas, D. S. Kothari Post-doctoral fellow working with me.

II. *Study of Phase transition in Spin-1 System* by **Arup Roy** of Rajabazar Science College

### **31. Ph. D. Thesis Awarded**

(i). Thesis Submitted to University of Calcutta for Ph.D degree by **Mrs. Sreetama Dutta** in February, 2009 and recommended for Ph.D degree.

Title: The role of defects on structural, electrical and optical properties of II-VI semiconductors and nanomaterials

(ii) Thesis submitted to University of Calcutta for Ph.D. degree by **Mr. Soubhik Chattopadhyay**, October, 2010 and recommended for Ph.D. degree.

Title of Thesis: Study of defects and physical properties of ZnO and Si<sub>3</sub>N<sub>4</sub>

(iii) Mr. Pradipta Kumar Mandal

Regn. No. 1896 Ph.D (Sc) Proceed/2012 dated 26.04.2012

Title of Thesis: Surface Growth With Extended Particles

**( Ph.D. Awarded 2018)**

(iv) Mr. Palash Nath

Regn. No. 4991 Ph.D (Sc) Proceed/11 dated 08.12.2011

Title of Thesis: Theoretical Study Of Electronic Band Structure And Transport Properties OF Doped And Defective Graphene System

**(Ph.D. Awarded 2015)**

(v) Manoj Marik

Regn. No. 2078 Ph. D(Sc) Proceed/12 dated 03.05.2012

Title of Thesis: Dielectric And Electro-optic Investigations Of Some Blue Phase and Bent Core Liquid Crystal Systems.

**(Ph.D. Awarded 2015)**

**(vi) Suman Chowdhury** (jointly with Prof. Abhijit Mookerjee (Ex-SNBNCBS, Kolkata))

**DST-INSPIRE FELLOW**

**(Ph.D. Awarded 2017).**

(vii) **Shrabantika Ghose**

Regn. No. 0799 Ph.D (Sc) Proceed/12 dated 17.2.2012

Title of Thesis: Study of Defect Modified Physical Properties of Nanocrystalline Semiconducting Oxide Materials

**(Ph.D. Awarded 2018).**

(viii) **Saptarshi Pal**

Regn. No. 4992 Ph.D. (Sc) Proceed/11 dated 08.12.2011

Title of Thesis: Study Of Defects In ZnO Introduced By Ion Beam Irradiation

**(Ph.D. Awarded 2018).**

(ix) **Debalina Chakraborty** (Jointly with Dr. U. N. Nandi of Scottish Church College, Kolkata) **(Ph.D. Awarded 2018)**

(x) **T. N. Ghosh** ( Jointly With Dr. S. Saha, Dr. U. N.Nandi) **(Ph.D. Awarded 2018, Vidyasagar University)**

(xi) **Ritwika Das- DST-INSPIRE FELLOW ( Ph.D. Awarded, 2019)**

**32. Thesis Submitted:**

**(i) Namrata Dhar, DST-INSPIRE FELLOW**

**33. Students Registered for Ph.D. till date:**

- 1. Arka Bandyopadhyaya ( UGC/URF-SRF)**
- 2. Apu Mandal (UGC-SRF)**
- 3. Sujoy Kumar Mandal (CSIR JRF)**
- 4. Miss Sushmita Jana (State Fellowship)**
- 5. Supriya Ghosal (State Fellowship)**
- 6. Devdas Karmakar (CSIR JRF)**

7. **Debaprem Bhattacharya**
8. **Mainak Ghosh (CSIR, JRF)**

**34. (A) DST approved Project:**

A joint project (No:SR/S2/CMP-0054/2008) with Dr. Upendranath Nandi of Scottish Church College, Kolkata as Principal Investigator (PI) has been sanctioned by DST, 2009.

**The title of the project:** Electrical transport properties of  $R_{1-x}A_xMnO_3$  nano-composites with R as rare earth elements and A as divalent alkali metals.

**34. (B) DST approved Project:**

A joint project (No:SB/S2/CMP-099/2014) with Dr. Upendranth Nandi of Scottish Church College, Kolkata as Principal Investigator (PI) has been sanctioned by DST, 2014.

**The title of the project:** Measurement of flicker noise in mixed valence polycrystalline  $R_{1-x}A_xMnO_3$  manganites with R as rare earth elements and A as divalent alkali metals.

**(C) UGC Minor Projects:**

- (i) Dr. D. Das (PI), Narendrapur RKMR College, Narendrapur, Kolkata-103

PI and Co-PI	Title of the Project	Duration	Amount Sanctioned	Funding Agency
1. Dr. D. Das (PI) and Dr. D. Jana (Co-PI)	Study of Oxidation Kinetics of Nano-Structured Amorphous Silicon	2 Years (2001-2003)	Rs. 45,000/-	UGC, Minor Project F.PSW-027/01-02(ERO)

PI and Co-PI	Title of the Project	Duration	Amount Sanctioned	Funding Agency
2. Dr. D. Das (PI) and Dr. D. Jana (Co-PI)	Evolution of Structural and Opto-electronic Properties of Silicon Nitride and Silicon Carbide Nanoparticles with oxidation and investigation of their oxidation mechanism	2 Years (2005-2007)	Rs. 96,000/-	UGC, Minor Project F.PSW-044/04-05(ERO)

- (ii) Mr. Anindya Sarkar (PI), Bangabasi Morning College, Kolkata -9



PI and Co-PI	Title of the Project	Duration	Amount Sanctioned	Funding Agency
1. Mr. A. Sarkar (PI) and Dr. D. Jana (Co-PI)	Defect identification and their correlation with optical properties of II-VI semiconductors	2 Years (2006-2008)	Rs. 85,000/-	UGC, Minor Project (PSW-029/05-06)

(iii) Dr. S. Chattaopadhyaya (PI), Maulana Azad College, Kolkata -13

PI and Co-PI	Title of the Project	Duration	Amount Sanctioned	Funding Agency
1. Dr. S. Chattaopadhyaya (PI) and Dr. D. Jana (Co-PI)	A Study on nanosized CMR manganites	2 Years (2010-2012)	Rs. 1,77,000/-	UGC, Minor Project (PSW-130/10-11(ERO))

### 35. UGC D. S. Kothari Post-doctoral fellows joined in 2010- Till Date:

- (a) Dr. Shyamal Biswas (2010-13)
- (b) Dr. Mahuya Chakrabarty (2010-13)
- (c) Dr. Kajari Das (2014-17)
- (d) Dr. Sumit Mandal (SERB, 2016- 2018)
- (e) Dr. Sumona Sinha (2019-till date)

### 36. Some cited papers.

1. P. B. Sunil Kumar and **D. Jana**, Imbibition: Experiments and Simulations, Physica A, **224**, 199 (1996). (*17 times*)

2 . **D. Jana**, Charged Scalar Field in an external magnetic field: Renormalization and Universal Diamagnetism, Nucl. Phys. B, **473[FS]**, No. 3, 659-684 (1996). (*9 times*)

3. **D. Jana** and J. Fort, A Simple Scaling Approach to Mott Conductivity Law, Physica B, **344**, 62-65 (2004). (*18 times*)

4. S. Dutta, M. Chakrabarty, S. Chattopadhyay, A. Sarkar, D. Sanyal and **D. Jana**, Defect Dynamics of ZnO by Positron Annihilation Spectroscopy, *J. Appl. Phys.*, **98**, 053513 (2005). (85 times)
5. Sreetama Dutta, **D. Jana**, S. Chattopadhyay, A. Banerjee, S. Manik, S. Pradhan and A. Sarkar, Annealing effect on nano-ZnO powder studied from positron life time and optical spectroscopy, *J. Appl. Phys.* **100**, 114328 (2006). (119 times)
6. Palash Nath, Suman Chowdhury, Dirtha Sanyal and **Debnarayan Jana**, Ab-initio calculation of electronic and optical properties of nitrogen and boron doped graphene nanosheet, *Carbon*, **73**, 275 (2014). (123 times)
7. **D. Jana**, L. C. Chen, C. W. Chen, S. Chattopadhyay and K. H. Chen, A First Principles Study of optical properties of  $B_xC_y$  single wall nanotubes, *Carbon*, **45**, 1482 (2007). (39 times)
8. Soubhik Chattopadhyay, Sreetama Dutta, Aritra Banerjee, Sudipta Bandyopadhyay **Debnarayan Jana**, Sanjay Chattopadhyay, Anindya Sarkar, Synthesis and characterization of Mn doped single phase ZnO, *Physica B*, **404**, 1509 (2009). (52 times)
9. Pradipta Kumar Mandal and **D. Jana**, Multifractal behavior of the surfaces evolved with surface relaxation, *Phys. Rev. E*, **77**, 061604 (2008) (7 times)
10. J. Fort, **D. Jana** and J. Humet, Multi-delayed Random Walks: Theory and Application in Neolithic Transition in Europe, *Phys. Rev. E*, **70**, 031913 (2004). (67 times)
11. Sreetama Dutta, Sanjay Chattopadhyay, Manas Sutradhar, Anindya Sarkar, Mahuya Chakrabarti, Dirtha Sanyal and **Debnarayan Jana**, Defects and the optical absorption in nanocrystalline ZnO, *Journal of Physics: Condensed Matter*, **19**, 236218 (2007). (78 times)
12. **D. Jana**, Anirban Chakraborti, L. C. Chen, C. W. Chen, and K. H. Chen, First-principles calculations of the optical properties of  $C_xN_y$  single walled nanotubes, *Nanotechnology*, **20**, 175701 (2009). (35 times)
13. Arnab Majumder, Suman Chowdhury, Palash Nath and **Debnarayan Jana**, Defect induced magnetism in silicene: A first principles study, *RSC. Advances*, **4**, 32221 (2014). [30 times]
14. Size dependent magnetic and optical properties in diamond shaped graphene quantum dots: A DFT study, R. Das, N. Dhar, A. Bandyopadhyaya and **D. Jana**, *Journal of Physics and Chemistry of Solids*, **99**, 34-42 (2016) [32 times]
15. Palash Nath, Dirtha Sanyal and **Debnarayan Jana**, Ab-initio calculation of optical properties of AA-stacked bilayer graphene with tunable layer separation, *Current applied Physics*, **15**, 691 (2015). [15 times]

16. S. Chattopadhyay, Sreetama Dutta, **D. Jana**, S. Chattopadhyay, A. Sarkar, P. Kumar, D. Kanjilal, D.K. Mishra and S. K. Ray, Interplay of Defects in ZnO by low energy Ar irradiation, *Jour. Appl. Phys.*, **107**, 113516 (2010). [40 times]
17. Sujoy Kumar Mondal, Kajari Das, Saptarshi Pal, Sumit Mandal, Abhigan Naskar, T.S. Bhattaharyya, Achintya Singha, Rezaul Saikh, Sukanta De and **Debnarayan Jana**, Engineering of next generation ZnO quantum dot/rGO photocatalyst for rapid degradation of toxic dyes, *Mat. Chem. Phys.*, **223** 456 (2019).[ 32 times]

### 36. High Impact review article (27.717):

- (1) Sreetama Dutta, Sanjay Chattopadhyay, Anindya Sarkar, Mahuya Chakrabarti, Dirtha Sanyal and **Debnarayan Jana**, Role of defects in tailoring structural, electrical and optical properties of ZnO, *Progress in Material Science*, **54**, 89 (2009) (290 times)
- (2) **D. Jana**, C.L. Sun, **L.C. Chen** and K.H. Chen, Effect of chemical doping of boron and nitrogen on the electronic, optical and electrochemical properties of carbon nanotubes, *Prog. Mat. Sc.*, **58**, 565 (2013). (220 times)
- (3) **Upendranath Nandi**, **Debnarayan Jana** and Deep Talukdar, Scaling Description of Non-Ohmic Direct Current Conduction in Disordered Systems, *Prog. Mat. Sc*, **71**, 1 (2015). (18 times)
- (4) Suman Chowdhury, and **Debnarayan Jana**, A theoretical review on electronic and optical properties of silicene, *Reports On Progress in Physics*, **79**, 126501 (2016). [123 times]
- (5) Arka Bandyopadhyay and D. Jana, A review on the role of tetra-rings in the graphene systems and their possible applications, *Reports on Progress in Physics*, **83**, 056501 (2020). [3 times]

### 37. Thesis Examined:

- (1) Electronic Structure of Ti-V alloys by Mr. Man Singh for the Doctor of Philosophy in Physics in Bundelkhand University, Jhansi (India) under the supervision of Dr. S. S. Rajput in 2009-2010.
- (2) Monte Carlo Simulations of Continuous Spin Models and Biaxial Nematics" by Nababrata Ghoshal submitted to Jadavpur University, 2012.
- (3) Growth, Crystallographic, Structure, Physical, Magnetic Characterization of Oxide Based Dilute Magnetic Semiconductors (DMS) by S. Francis, Madurai Kamraj University, 2014.

**38. Books Written:** For CSIR-NET/UGC-NET- **Target SET NET (Part –I)** General Science for M. Sc. students (published by D. N. Prakashan Pvt. Ltd, Kolkata, India, 2009).

CSIR-NET/UGC-NET- **Target SET NET (Part –II)** Physical Science for M. Sc. and advanced B.Sc.Students (published by D. N. Prakashan Pvt. Ltd, Kolkata, India, 2010)

With Dr. Upendranath Nandi, **Nanomaterials: Theory, Problems and Solutions**, A B. Sc. (Hons.) book according to latest UGC syllabus (Techno World, Kolkata, September, 2020)  
ISBN No: **978-9-3883-4758-7**

**Amazing Power of Dimensional Analysis**, (Techno World, Kolkata, November, 2020)  
ISBN No: **978-9-3883-4726-6**

**39. Invited book published by Lambert Academic Publishing (LAP), Germany, 2011.**

**Title:** *A statistical description of electrical transport in disordered systems*  
**Authors:** *Debnarayan Jana and Upendranath Nandi*  
**ISBN No.-** **978-3-8454-0715-9**

**Title:** *Dimensional Analysis: Modern Perspectives*  
**Author:** *Debnarayan Jana*  
**ISBN No.-** **978-3-8465-3142-6**

#### **40. Google Scholar Citations:**

	<b>All</b>	<b>Since 2015</b>
<a href="#">Citations</a>	2169	1568
<a href="#">h-index</a>	23	20
<a href="#">i10-index</a>	46	41