

Sujoy Ghosh

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EDUCATION

PHD IN APPLIED PHYSICS | SOUTHERN ILLINOIS UNIVERSITY CARBONDALE

August 2011- December 2016 | Carbondale, Illinois • GPA: 4/4

MS IN PHYSICS | SOUTHERN ILLINOIS UNIVERSITY CARBONDALE

August 2009 – August 2011 | Carbondale, Illinois • GPA: 3.84/4

MS IN PHYSICS | UNIVERSITY OF CALCUTTA

August 2006 – August 2008 | Kolkata, India • CGPA: 4.26/6

BS IN PHYSICS | UNIVERSITY OF CALCUTTA

August 2003 – August 2006 | Kolkata, India • Overall grade: 57%

WORK & RESEARCH EXPERIENCE

POSTDOCTORAL RESEARCH ASSOCIATE | UNIVERSITY OF NEW HAMPSHIRE

January 2017 – Present | Durham, New Hampshire

Working on projects related to two-dimensional (2D) nano-materials based devices for bio-sensing and energy storage applications

- Liquid-phase synthesis of layered nano-materials such as graphene, NbSe₂, MoS₂ etc.
- Materials characterization via AFM, Raman and UV-Vis spectroscopy
- Electrochemical energy storage applications utilizing nano-materials based electrodes
- Fabrication of graphene based field effect transistor (GFET) devices via photolithography
- Characterization and optimization of GFET devices for aptamer-based selective bio-sensing applications
- Design and fabrication of prototype microfluidic devices for graphene based biosensor

GRADUATE RESEARCH ASSISTANT | SOUTHERN ILLINOIS UNIVERSITY CARBONDALE

January 2011 – December 2016 | Carbondale, Illinois

Worked on projects related to advanced two-dimensional (2D) semiconductors, Graphene and CNT based devices

- Synthesized various nano-materials via several top-down and bottom-up approaches such as liquid phase exfoliation, mechanical exfoliation and chemical vapor deposition (CVD) techniques
- Designed and set up analog circuitry for automated electronic and opto-electronic transport measurement system
- Fabricated and characterized field effect transistor (FET) devices for electronic and opto-electronic device applications
- The electronic device characterization includes low temperature electronic transport (D.C & A.C), current-voltage characteristics, charge carrier density and mobility, surface traps, interface states, Ohmic contact qualities etc.
- Performed optoelectronic property evaluation of photodetectors. The optoelectronic device characterization includes photoconduction, responsivity, external quantum efficiency, detectivity, switching parameters etc.
- Fabricated supercapacitors using graphene, CNTs and other nanostructured materials and performed electrochemical characterization via charge-discharge, cyclic voltammetry, electrochemical impedance spectroscopy and circuit analysis

RESEARCH INTERN | HELMHOLTZ-ZENTRUM BERLIN FÜR MATERIALIEN UND ENERGIE

June 2015 – August 2015 | Berlin, Germany

Projects related to metastable effects in CIGSe thin film solar cells

- Light soaking and dark soaking experiments
- Current-Voltage (I-V) characteristics measurements
- Capacitance-Voltage (C-V) measurements
- Quantum efficiency (EQE) spectroscopy measurements
- Photo-luminescence (PL) spectroscopy measurements

GRADUATE TEACHING ASSISTANT |SOUTHERN ILLINOIS UNIVERSITY CARBONDALE

August 2009 – December 2010 |Carbondale,Illinois

Taught undergraduate college physics laboratory courses on Mechanics, Electricity and Magnetism (with 100+ students)

- Short lecturing in a small classroom setting on theoretical aspects of fundamental physics and demonstration of the experimental procedures
- Lectures involved use of modern pedagogical aspects of active learning such as use of PASCO data collection and analysis software, videos and animations etc.
- Initiating classroom discussions to give the students a chance to ask questions
- Developed laboratory quizzes and exams that meets the university's curriculum and learning standards
- Graded quizzes,exams and the resulting lab reports
- Providing extra help with student's questions and concerns during office hours

AWARDS

2015 Deutscher Akademischer Austausch Dienst (DAAD) scholarship for further study and training in Germany

2014 Dissertation Research Assistantship Award,Southern Illinois University Carbondale

2013 Best Postar Presentation Award in Physical Sciences,Southern Illinois University Research Town Meeting

2013 Best Oral Presentation Award in MRS Spring Meeting,Symposium O, Beyond Graphene – 2D Atomic Layers

SKILLS (EXPERIMENTAL & INSTRUMENTATION)

DEVICE FABRICATION

- Photolithigraphy-OAI Mask Aligner
- Edwards 306A thermal evaporator and plasma cleaner
- Denton Vacuum Desk IV sputter coater

MATERIALS CHARACTERIZATION

- NT-MDT spectrum instruments Raman and AFM
- Thermo Nicolet iS10 FT-IR and Hach DR/4000U UV-Vis spectrometer
- FEI Scanning electron and Transmission electron microscope

ELECTRONIC CIRCUIT DESIGN AND ANALYSIS

- Current/Voltage Source meter (Kiethley 2400,2410,2450,Keysight B2900)
- L-C-R meter (HP 4284A)
- Current amplifiers, digital oscilloscope, function generators, lock-in analyzer

HIGH VACUUM AND LOW TEMPERATURE ELECTRICAL MEASUREMENT

- Janis SHI-4-1 closed cycle refrigerator
- LakeShore 325 temperature controller
- Micromanipulator general purpose manual probe station
- Quantum design VersaLab

OPTO-ELECTRONICS MEASUREMENTS

- Princeton Instruments SP-2300i monochromator
- Coherent cube automated laser system

ELECTROCHEMICAL CHARACTERIZATION

- PARSTAT 2263 (with Frequency Response Analyzer),Gamry instruments reference 600 and bio-logic electrochemical workstation
- Gamry instruments Quartz crystal microbalance

INSTRUMENT AUTOMATION,MAINTENANCE,TROUBLESHOOTING AND DATA ANALYSIS

- LabView,Origin,Matlab,MS Office,IGOR Pro

MISCELLANEOUS

- Bath sonicator and Horn tip sonicator,spin coater,high temperature furnace,wire bonder

PUBLICATIONS

IN PREPARATION/SUBMISSION/REVIEW

- 2018 Liquid Phase Exfoliated NbSe₂ for Flexible Energy Storage Devices (in preparation)
H.Ahmad,S. Ghosh,G.Dutta, A.Maddaus and E.Song
- 2018 Temperature Dependant Photo-conduction in Few Layer InSe Phototransistor (in preparation)
M.Wasala,S. Ghosh,P.Patil,S.Lei, R.Vajtai, P.M.Ajayan and S.Talapatra
- 2018 Electronic Transport in Few Layer CuIn₇Se₁₁ Field effect transistors(in preparation)
P.Patil,S. Ghosh, M.Wasala, S.Lei, R.Vajtai, P.M.Ajayan and S.Talapatra

PUBLISHED

- 2018 Low Temperature Studies of Photoconduction in Few Layer p-type Tungsten Diselenide (WSe₂) Field Effect Transistors (FET),**Nanotechnology**,**29(48),484002**.
S. Ghosh, M.Wasala,P.Patil, N.R. Pradhan, D.Rhodes, M.Fralaide, Y. Xin, S. A. McGill, L.Balicas and S.Talapatra
- 2018 High Performance Graphene Based Electrochemical Double Layer Capacitors Using 1-butyl-1-methylpyrrolidinium tris (pentafluoroethyl) trifluorophosphate [BMP][FAP] Ionic Liquid as Electrolyte,**Electronics** **2018, 7(10), 229**.
J.Huffstutler, M.Wasala, J.Richie, J.Barron, A.Winchester, S. Ghosh, C.Yang, W.Xu, L.Song, S.Kar, S.Talapatra
- 2018 Selective Detection of a Protein Biomarker Utilizing a Large Area CVD-Grown Graphene-Based Field Effect Transistor,**Frontiers in Bioengineering and Biotechnology** **6, 29**.
S. Ghosh,N.I.Khan, J.G.Tsavalas and E.Song
- 2017 Fast Photoresponse and High Detectivity in Copper Indium Selenide (CuIn₇Se₁₁) Phototransistors **2D Mater.** **5 (1),015001**.
S. Ghosh,P.Patil,M.Wasala,S.Lei, A.Nolander,S.Pooplasingam, R.Vajtai, P.M.Ajayan, S.Talapatra.
- 2017 Adsorption Energy of Oxygen Molecules on Graphene and Two-dimensional Tungsten Disulfide **Scientific Reports** **7, 1774**.
F.R. Bagsican , A.Winchester ,S. Ghosh , X.Zhang , L.Ma , M.Wang , H. Murakami , S.Talapatra , R.Vajtai , P.M. Ajayan , J.Kono , M.Tonouchi,I.Kawayama.
- 2016 Laser THz Emission Spectroscopy of Gas Adsorption-Desorption Dynamics in Tungsten Disulfide **Nanosheets.e-J. Surf. Sci. Nanotech.**,**14,78-82**.
F.R Bagsican, I.Kawayama, H.Murakami,M.Tonouchi,A.Winchester, S. Ghosh, S.Talapatra
- 2016 UV Photo detection Using ZnO Nanowires Grown Via Chemical Bath Deposition Using a Modified Seeding Technique. **J. Appl. Phys.****119,084306**.
A. Al-Asadi, L. Henley, S. Ghosh, A. Quetz, I. Dubenko, N. Pradhan, L. Balicas, N. Perea Lopez, V. Carozo, Z. Lin, M. Terrones, S. Talapatra,N. Ali
- 2016 Effect of Underlying Boron Nitride (BN) Thickness on Photoresponse in Molybdenum Disulfide (MoS₂)-BN Heterostructures. **Journal of Materials Research**,**31(7),893-899**.
M. Wasala, J. Zhang, S. Ghosh, B. Muchharla, R. Malecek, D. Mazumdar, H.Samassekou, M. Gaither-Ganim, A. Morrison, N-P Lopez, V. Carozo, Z. Lin, M. Terrones, and S. Talapatra
- 2016 Fractional PhotoCurrent Dependence of Graphene Quantum Dots Prepared from Carbon Nanotubes. **Phys. Chem. Chem. Phys.****17, 24566-24569**.
S. Kundu, S.Ghoh, M. Fralaide, T.N. Narayanan, V. K. Pillaia, S. Talapatra

- 2015 Ultrafast Intrinsic Photoresponse and Direct Evidence of Sub-gap States in Liquid Phase Exfoliated MoS₂ Thin Films. **Scientific Reports 5, 11272.**
S. Ghosh, A. Winchester, B. Muchharla, M. Wasala, S. Feng, A. L. Elias, M. B. Murali Krishna, T. Harada, C. Chin, K. Dani, S. Kar, M. Terrones, S. Talapatra
- 2014 Universal ac Conduction in Large Area Atomic Layers of CVD Grown MoS₂. **Phys. Rev. B 89.**
S. Ghosh, S. Najmaei, S. Kar, R. Vajtai, J. Lou, N. R. Pradhan, L. Balicas, P. M. Ajayan and S. Talapatra
- 2014 Electrochemical Characterization of Liquid-Phase Exfoliated 2D Layers of Molybdenum Disulfide. **ACS Appl. Mater. Interfaces 6 (3), 2125–2130.**
 A. Winchester, S. Ghosh, S. Feng, A. L. Elias, T. Mallouk, M. Terrones, S. Talapatra
- 2013 Photosensor Device Based on Few-Layered WS₂ Films. **Adv. Funct. Mat. 23, 5511– 5517.**
 N. Perea-López , A. L. Elías , A. Berkdemir , A. Castro-Beltran , H. R. Gutiérrez , S. Feng , R. Lv , T. Hayashi , F. López-Urías , S. Ghosh , B. Muchharla , S. Talapatra , H. Terrones, M. Terrones
- 2012 Effect of 1- Pyrene Carboxylic-Acid Functionalization of Graphene on Its Capacitive Energy Storage. **J. Phys. Chem. C 116, 20688-20693.**
S. Ghosh, X. An, R. Shah, D. Rawat, B. Dave, S. Kar, S. Talapatra

CONFERENCE PRESENTATION

CONTRIBUTED TALKS

- 2018 Liquid Phase Exfoliated Niobium Diselenide (NbSe₂) for Electrochemical Energy Storage Applications
78th Physical Electronic Conference, Durham, NH
S. Ghosh, G. Dutta, H. Ahmad, Alec G. Maddaus and E. Song
- 2017 Liquid Phase Exfoliated NbSe₂ and NbSe₂/Conducting Polymer Based Hybrid Two-Dimensional Nanomaterials for Flexible Energy Storage Devices
Materials Research Society Fall Meeting, Abstract: NM04.07.02, Boston, MA
S. Ghosh, A. Maddaus, B. Si, S. Hollen, J. Tsavalas, E. Song
- 2016 Electronic Transport and Photo-Current Generation in Few Layer n-Type CuInSe Field Effect Transistor
Materials Research Society Spring Meeting, Abstract: EP10.2.09, Phoenix, AZ
S. Ghosh, M. Wasala, P. Patil, S. Lei, R. Vajtai, P. M. Ajayan, S. Talapatra
- 2015 Electronic and optoelectronic properties of Few Layer MoS₂ Flake
American Physical Society March Meeting, Abstract: S2.00010, San Antonio, TX
 J. Zhang, S. Ghosh, M. Wasala, S. Talapatra
- 2015 Temperature dependent photoconduction in atomically thin Layers of Indium Selenide
American Physical Society March Meeting, Abstract: S2.00010, San Antonio, TX
S. Ghosh, M. Wasala, J. Zhang, S. Lei, R. Vajtai, P. M. Ajayan, S. Talapatra
- 2014 Photoconduction in Few Layer Tungsten Diselenide (WSe₂) FETs
Materials Research Society Fall Meeting, Abstract: J13.01, Boston, MA
S. Ghosh, M. Wasala, N. R. Pradhan, D. Rhodes, L. Balicas, S. Talapatra
- 2014 Synthesis and Photoresponse of Few Layer Liquid Phase Exfoliated Molybdenum Disulfide (MoS₂) Flakes
American Physical Society March Meeting, Abstract: BAPS.2014.MAR.F51.13 Denver, CO
S. Ghosh, B. Muchharla, A. Winchester, S. Feng, A. L. Elias, N. Perea Lopez, S. Kar, M. Terrones, S. Talapatra
- 2013 Electrical Transport in Large Area CVD Grown MoS₂
Materials Research Society Spring Meeting, Abstract: O5.04, San Francisco, CA
S. Ghosh, S. Najmaei, Z. Liu, R. Vajtai, P. M. Ajayan, S. Talapatra

- 2013 Electrical Transport Properties of Liquid Phase Exfoliated MoS₂ Thin Films
American Physical Society March Meeting, Abstract: T23.00006, Baltimore, MD
S.Ghosh, A.Winchester, A.L. Elias, N.R.Pradhan, L.Balicas, M.Terrones, S. Talapatra
- 2013 Electrical Characterization of Graphene Flakes Synthesized Using Liquid Phase Exfoliation of Graphene
American Physical Society March Meeting, Abstract: C6.00008, Baltimore, MD
S.Talapatra, B.Muchharla, M.Connolly, A.Winchester, S.Ghosh, S.Kar
- 2012 Investigation of Electrochemical Gate Controlled Charge Transport in Large Area Boron-Nitrogen Doped Graphene
American Physical Society March Meeting, Abstract: H12.00002, Boston, MA
S.Ghosh, S.Kar, Z.Liu, R.Vajtai, P.M.Ajayan, S.Talapatra
- 2011 1-pyrenecarboxylic acid functionalization of graphene: effect on capacitive energy storage
American Physical Society March Meeting, Abstract: B20.00010, Dallas, TX
S.Ghosh, R.Shah, X.An, D.Rawat, S.Kar, S.Talapatra

INVITED TALKS

- 2016 Electronics, Opto-electronics and Energy Storage Device Applications with 2D Materials: Novel Aspects, Challenges and Future Possibilities, **University of New Hampshire, USA**
- 2014 Synthesis, electronic transport properties and applications of Graphene and MoS₂
Central Electrochemical Research Institute, Karaikudi, India

POSTER PRESENTATION

- 2015 Photoconduction in Few Layer Tungsten Diselenide (WSe₂) FETs
Center for Undergraduate Research and Creative Activities, SIUC
- 2013 Electrical Transport in Large Area CVD Grown Few Layer MoS₂
Research Town Meeting, Carbondale, IL

CONTRIBUTED CONFERENCE ABSTRACTS

- 2010 Ultrathin Graphene Membranes as Flexible Electrodes for Electrochemical Double Layer Capacitors
Abstract: X21.00008, APS March Meeting, Portland, OR
S.Talapatra, S.Kar, R.Shah, S.Ghosh, X.An, T.Simmons, M.Washington, S.Nayak
- 2012 Performance of Multi Walled Carbon Nanotubes Grown on Conductive Substrates as Supercapacitors Electrodes using Organic and Ionic liquid electrolytes
Abstract: BAPS.2012.MAR.C1.320, APS March Meeting, Boston, MA
A.Winchester, S.Ghosh, B.Turner, X.F. Zhang, S.Talapatra
- 2013 Electrical Characterization of Graphene Flakes Synthesized Using Liquid Phase Exfoliation of Graphite in Isopropyl Alcohol
Abstract: C6.00008, APS March Meeting, Baltimore, MD
S.Talapatra, B.Muchharla, M.Connolly, A.Winchester, S.Ghosh, S.Kar
- 2013 Large Area Synthesis of WS₂ Crystalline Sheets Directly on SiO₂ and Their Transfer to Other Substrates
Abstract: BAPS.2013.MAR.Q1.251, APS March Meeting, Baltimore, MD
A.L.Elias, N.Perea-Lopez, A.Castro-Beltran, A.Berkdemir, S.Feng, R.Lv, A.Long, T.Hayashi, Y.A. Kim, M.Endo, H.R. Gutierrez, S.Ghosh, S.Talapatra, N. R. Pradhan, L.Balicas, F.Lopez-Urias, H.Terrones, M.Terrones
- 2013 Photocurrent studies on continuous large area monolayers of WS₂ and MoS₂
Abstract: BAPS.2013.MAR.R38.9, APS March Meeting, Baltimore, MD
N.Perea-Lopez, A. L. Elias, H.R. Gutierrez, R. Lv, A.Castro-Beltran, S.Talapatra, , S.Ghosh, A.Berkdemir, F.Lopez-Urias, H.Terrones, M.Terrones

- 2013 Large Area Synthesis of WS₂ Crystalline Sheets Directly on SiO₂ and Their Transfer to Other Substrates
Abstract: O3.04, MRS Spring Meeting, San Francisco, CA
 A.L. Elias, N.Perea-Lopez, A.Castro-Beltran, A.Berkdemir, S.Feng, R.Lv, A.Long, T. Hayashi, Y.A.Kim, M.Endo, H.R. Gutierrez, S.Ghosh, N.R. Pradhan, L.Balicas, S.Talapatra, F.Lopez-Urias , H.Terrones, M.Terrones
- 2013 Electrochemical Characterization of Liquid Phase Exfoliated Layers of MoS₂
Abstract: O3.17, MRS Spring Meeting, San Francisco, CA
 A.Winchester, S.Ghosh, A.L.Elias, M. Terrones, S.Talapatra
- 2013 Photocurrent Studies on Continuous Large Area Monolayers of MoS₂
Abstract: O7.09, MRS Spring Meeting, San Francisco, CA
 N.Perea-Lopez, A.L. Elias-Arriaga, H.Rodriguez-Gutierrez, R.Lu, A.Castro-Beltran, A.Berkdemir, S.Talapatra S.Ghosh, F.Lopez-Urias , H.Terrones, M.Terrones
- 2014 Synthesis and Electrochemical Characterization of Liquid Phase Exfoliated Graphene Flakes
Abstract: H1.00337, APS March Meeting, Denver, CO
 J.Richie, J. Huffstutler, M.Wasala, A.Winchester, S.Ghosh, S.Kar, S.Talapatra
- 2014 High Performance Graphene Electrochemical Double Layer Capacitors Using 1-butyl -1-methylpyrrolidinium tris (pentafluoroethyl) trifluorophosphate [BMP][FAP] Ionic Liquid as Electrolyte
Abstract: K19.04, MRS Fall Meeting, Boston, MA
 M.Wasala, J.Huffstutler, J.Richie, A.Winchester, S.Ghosh, Y.Chao, W.Xu, L.Song, S. Kar, S.Talapatra
- 2014 Synthesis and Characterization of Liquid Phase Exfoliated Tungsten Disulphide (WS₂) Flakes
Abstract: A51.011, APS March Meeting, Denver, CO
 M.Wasala, S.Ghosh, A. Winchester, L.Moore, B. Nichols, M.Dubey, S.Talapatra
- 2014 Performance of Liquid Phase Exfoliated Graphene As Electrochemical Double Layer Capacitors Electrodes
Abstract: J25.00003, APS March Meeting, Denver, CO
 J.Huffstutler, M.Wasala, J.Richie, A.Winchester, S.Ghosh, S.Kar, S.Talapatra
- 2015 Synthesis and Photoresponse of Hydrothermally Grown ZnO Nanowires
Abstract: M26.00001, APS March Meeting, San Antonio, TX
 A.Al-Asadi, L.Henley, S.Ghosh, A.Quetz, I.Dubenko, N.Pradhan, L.Balicas, S. Talapatra, N.Ali
- 2015 Electronic and optoelectronic properties of Few Layer MoS₂ Flake
Abstract: S2.00002, APS March Meeting, San Antonio, TX
 J.Zhang, S.Ghosh, M.Wasala, S.Talapatra
- 2015 Electronic and photo-electronic transport in sputter deposited MoS₂ film
Abstract: S2.00006, APS March Meeting, San Antonio, TX
 M.Wasala, S.Ghosh, J.Zhang, J.Richie, D.Mazumdar, S.Kar, S.Talapatra
- 2016 Effect of Underlying Boron Nitride (BN) Thickness on Photoresponse in Molybdenum Disulfide (MoS₂)-BN Heterostructures
Abstract: EP10.1.02, MRS Spring Meeting, Phoenix, AZ
 M.Wasala, J.Zhang, S.Ghosh, B.Muchharla, R.Malecek, D.Mazumdar, H.Samassekou, M. Gaither-Ganim, A.Morrison, N.Perea Lopez, V.Carozo, Z.Lin, M.Terrones, S.Talapatra
- 2016 Field Effect Transistors Using Atomically Thin Layers of Copper Indium Selenide (CuInSe)
Abstract: P16.00015, APS March Meeting, Baltimore, MD
 P.Patil, S.Ghosh, M.Wasala, S.Lei, R.Vajtai, P.M.Ajayan, S.Talapatra
- 2017 Opto-Electronic Properties of Multilayer Indium Selenide (InSe) Field Effect Transistors
Abstract: NM04.04.12, MRS Fall Meeting, Boston, MA
 M.Wasala, P.Patil, S.Ghosh, S.Lei, R.Vajtai, P.M.Ajayan, S.Talapatra

- 2018 Low Temperature Electronic Transport in Field-effect Transistors based on 2D Layers of Copper Indium Selenide ($\text{CuIn}_7\text{Se}_{11}$)
Abstract: L37.00006 , APS March Meeting, Los Angeles, CA
P.Patil, M.Wasala,S.Ghosh, S.Lei, R.Vajtai, P.M.Ajayan, S.Talapatra
- 2018 Selective Detection of a Protein Biomarker Utilizing a Large Area CVD-Grown Graphene-Based Field Effect Transistor
Microfluidics, Sensors and Devices 2, Abstract no.2485, 233th ECS meeting, Seattle, WA
S.Ghosh, N.I.Khan, E.Song