

Somenath Chatterjee, PhD

Professor

Dept. of Physics
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Adamas University,
Kolkata, India
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Web: <https://scholar.google.co.in/citations?user=6n7TCJIAAAAJ&hl=en>,
<http://yuekuo.tamu.edu/Somenath%20Chatterjee.htm>

Personal Information:

Name: Dr. Somenath Chatterjee
Date of Birth: 15/05/1974
Father's Name: Late M. K. Chatterjee
Gender: Male
Nationality: Indian
Cast: General
Permanent Address: A-4, Bidhan nagar,
Po.+ Dist. Midnapur (West), pin: 721101, India

Professional Preparation

Ph D 2004

Materials Science, Indian Institute of Technology, Kharagpur, India

M Sc (with Distinction) 1997

Physics (Specialization: Solid State Physics), Vidyasagar University, India

B Sc (with Distinction) 1995

Physics, Vidyasagar University, India

Research Experience

2008 – 2009

CNRS Fellow

Photovoltaics Group, InESS (Institute of Electronics of Solids and Systems)
CNRS-UMR-7163, Universite de Louis Pasteur, Strasbourg, France

2007 – 2008

Nanotechnology Scientist

Electrical Engineering and Computer Science Department,
South Dakota State University, Brookings, SD, USA

2003 – 2006

Post-Doctoral Research Associate

Thin Film Nano and Microelectronics Research Laboratory,
Texas A&M University, College Station, Texas, USA

1999 – 2003

Research Scientist

Microelectronics Center, Department of Electronics and Electrical Communication
Engineering, Indian Institute of Technology, Kharagpur, India

Academic Experience:

May 2022- Till date

Professor,

Dept. of Physics
Adamas University, Kolkata, India

August 2016- May 2022

Professor & Head

Centre for Materials Science and Nano Technology
Department of Electronics and Communication Engineering
Sikkim Manipal Institute of Technology, Sikkim Manipal University, India

July 2011- July 2016

Associate Professor

Centre for Materials Science and Nano Technology
Department of Electronics and Communication Engineering
Sikkim Manipal Institute of Technology, Sikkim Manipal University, India

July 2009 – July 2011

Assistant Professor

Department of Electronics and Communication Engineering,
Techno India, Salt Lake, Kolkata, *Under* West Bengal University of Technology, India

March 2006 – July 2007

Assistant Professor

School of Electrical Sciences, Vellore Institute of Technology, Tamil Nadu, India

Research Project

- *Cost Effective Synthesis of Graphene and metal –incorporated Graphene: their application as Sensors of environmental gases, as Co-PI, Sanctioned Amount: INR 91 Lakhs, Sponsored by DeitY, Govt. of India, Duration: 3Years, Started: October, 2013*
- *Synthesis, Characterization, and Photocatalytic Activity of Pure and Metal Doped Semiconductor Nanocomposites, as PI/Scientist, sanctioned Amount: ~ INR 26 lakhs, Sponsored by DST-WOS-A scheme, Govt. of India, started: September 2014, Duration: 3Yrs.*

- *Cost-effective thin-film polycrystalline-silicon solar modules*, as PI, Sponsoring agency: DST, Govt. of India, *sanctioned*, Cost: ~ **INR 110 Lakhs** Duration: 4 Years *Started*: March, 2015.
- *Photocatalytic Degradation of used LASER dye solution*, as PI, Sponsoring agency: Department of Atomic Energy (DAE), Board of Research in Nuclear Sciences (BRNS), Govt. of India, *Sanctioned*, Cost: ~ **INR 30 Lakhs**, Duration: 3 Years *Started August, 2018*.
- *Gate electrodes and gate dielectrics for 45-nm CMOS generation*, Sponsored by Sematech Corporation., USA, as Post-doctoral, *Completed*, 2004-05

Synergistic Activities

- **Reviewer:** *Journal of Electrochemical Society, Elsevier Journal: Physica B, Materials Chemistry and Physics, Results in Physics, Material Letters, Renewable and Sustainable Energy Reviews etc. IEEE Electron Device Letter, Journal of Nanostructure in Chemistry, Springer.*

Activities

- **Invited Speaker on *Impact of Science & Technology in Society*** organized by DST-Sikkim, Govt. of India in relation with *Azadi Ka Amrit Mahotsav, 26th April, 2022*.
- ***ATAL Faculty Development Program on Nanodevices and Advanced Nanomaterials***, organized by AICTE & SMIT-Sikkim, 6th -10th December, 2021.
- **Resource Person in *ATAL Faculty Development Program on Nanodevices and Advanced Nanomaterials***, organized by AICTE & SMIT-Sikkim, 6th -10th December, 2021.
- **Resource Person in *Webinar on Advanced Nanotechnology, Versatile molecule and Spectroscopy***, organized by Association of Chemistry Teachers, Mumbai, 3rd-4th July, 2020.
- **Invited Talk in *International Conference on Engineering Sciences & Technologies for Environmental Care (ESTEC-2020)***, organized by CSIR-North East Institute of Science & Technology (NEIST), Jorhat, Assam, India during February 20-22, 2020.
- **Invited Talk in *Recent advancement in Renewable Energy and Material Science*** organized by Mechanical Engineering Department Sikkim Manipal Institute of Technology, Sikkim, India in association with Institution of Engineers, Sikkim on 8th December, 2019.
- **Organized One-day *Seminar on Concepts of Microscopic, Spectroscopic and Electrochemical Characterization Techniques of Nanomaterials*** in Sikkim Manipal Institute of Technology, Sikkim, India, 18th May, 2018.
- **Lecture on *Engineers towards Innovations* as Resource Person on Various Topics of Science and Technology** in Siliguri Institute of Technology, 24th July, 2019.
- **Invited Speaker on *Entrepreneurship Development program*** organized by Dept. of Science & Technology, Sikkim, 16th February, 2019.
- **Motivational Speech on *Engineers Towards Innovation: Entrepreneurs*** at Milan Utsav-2019, Park circus Maidan, Kolkata, West Bengal organized by West Bengal Minorities' Development & Finance Corporation, 4th February, 2019.

- **Invited Speaker** in *State level Faculty Development program on Entrepreneurship promotion* organized by Sikkim Consultancy Center and Sikkim Government College, 31st March, 2018, Sikkim, India.
- **Invited Speaker** in *First International Conference on Advanced Computational and Communication Paradigms (ICACCP)* on 08th -10th September 2017, Sikkim Manipal Institute of Technology, Sikkim, India.
- **Invited Speaker** in *Recent Trends in Material Research* on 7th September, 2017, Siliguri Institute of Technology, Siliguri, India.
- **Co-Convener** of *International Conference on Emerging Trends in Nano-science and Nanotechnology (ICETINN-2017)* on 16-18th March, 2017, Sikkim Manipal Institute of Technology, Sikkim, India.
- **Resource Person** in the **National workshop *Advances in Electronics*** jointly organized by Dept. of E&C Engg., SMIT, Sikkim and Center for Computer and Communication Technology, Chisopani, South Sikkim on 10/05/2016.
- **Invited Speaker** in “*7th Vidyasagar Satyendranath Bose National Workshop 2016 on Theory and Application of Advanced Materials (TAAM 2016)*” sponsored by DST, Govt. of India, S. N. Bose School of Basic Science, and Vidyasagar University, in Midnapore, 22nd – 24th March, 2016.
- **Invited Speaker** in “*International Conference on Microelectronics, Computing and Communication*” (**MICROCOM-2016**) sponsored by IEEE and NIT-Durgapur, in Durgapur, 23-25 January, 2016.
- **Technical Chair** in a 3 days North-East spring school on “*Mobile Networks: Devices to Computing (MNDC-2015)*” jointly organized by E&CE Dept., Sikkim Manipal Institute of Technology, Sikkim and ACMU, Indian Statistical Institute, Kolkata, in Sikkim, 14-16th February, 2015.
- **Member of Expert Committee** for promotion/upgradation of faculty members of all the Polytechnics in the State of Sikkim as directed by Human Resource development dept., Govt. of Sikkim (Ref# GOS/TECHED/2001/v(2) pt-III/319 dated 06/10/2015).
- **Invited Speaker** in “*National Conference on Materials Science for Energy Harvesting*” at Jubilee College, Under Vinobha Bhave University, Ranchi, 2015, India
- **Guest lecturer** at *National Institute of Technology (NIT), Sikkim*, 2014.
- **Invited Speaker** in TEQIP-II Sponsored Short-Term Course on *Emerging Materials and Devices* organized by *National Institute of Technology (NIT), Durgapur*, 2014.
- **Delivered** a lecture on **Recent Research Trends in Nanoelectronics** at *National Institute of Technology, Sikkim*, 2014.
- **Technical Chair** in a 5 days *National workshop on Communication & Information Technology And Devices for Electronics* jointly organized by UGCNRCPS, IPR, University of Calcutta, and Sikkim Manipal University, on March 18-22, 2013 in Sikkim.
- A UGC sponsored *National seminar: Laser and its Applications*, as an **Invited speaker**, topic: *LASER with Nanomaterials: Fabrication and Application* in Midnapur College,

2012, India

- **Resource person** in UGC Sponsored three days seminar on “*New sources of Energy using Nanotechnology*” in Jubilee College, Under Vinobha Bhave University, 2011, India.
- **Invited speaker** on “*Nanoelectronics- Moving technology forward*” in a workshop on Nanotechnology arranged by V.L.B Janakiammal College of Engineering & Technology - Coimbatore, Tamil Nadu, India, 2007.
- **Invited speaker** on “*Future of Nanoelectronics*” in Techno India, Salt Lake, West Bengal, India, 2006.

Awards and Honors

- SMU Pride Award **Research in Excellence-2018**, Sikkim Manipal University, India, 2018.
- International Travel Grant, Dept. of Science & Technology, India, 2011.
- Post-Doctoral Fellowship, Centre National de la Recherche Scientifique (CNRS), France (2008-09)
- Post-Doctoral Fellowship, National Science Foundation (NSF), USA (2003 – 2006)
- PhD Fellowship, Ministry of Information Technology, India (2001- 2003)

AICTE-Swayam online Course: Elements of Nanotechnology: Novice to Professional

Educational Channel: *Teach Me Electronics:*

<https://www.youtube.com/channel/UCAuMmGctUIFx51FI7bVtUkQ>

Laboratory Setup @ SMIT For PhD and PG students:

https://smu.edu.in/content/dam/manipal/smu/smit/documents/research/Instrument_CMSNT.pdf

PhD Supervision: Awarded: **03** Continuing: **02**

Publications:

- **h-index: 25 according to Google Scholar 2024**
 - **International Journal: 76, National Journal: 02**
 - **International Conferences: 51, National Conferences: 16**
 - **Book Chapter: 05**
- Total Publications:**
150

Book Chapter:

- i. P. Basnet & S. Chatterjee, “Nanocomposites of ZnO for Water Remediation” in Edited book ‘Composites for Environmental *Engineering*’, *Scrivener Publishing, Wiley, USA*, November, 2019.

- ii. Esraa Gabal, **S. Chatterjee**, and Kamel A. Abd-Elsalam, “Carbon Nanomaterials Applications in Air Pollution Remediation” in “Carbon Nanomaterials for Agri-food and Environmental Applications”, *Elsevier*, USA, November 2019.
- iii. S. Das, S. Datta, **S. Chatterjee**, “A MATLAB-Based Simulator for Amorphous Silicon and Polycrystalline Silicon Thin Film Transistor”, *Advances in Electronics, Communication and Computing*, Pages 733-744, *Springer*, 2018.
- iv. P. Basnet and **S. Chatterjee**, “Biogenic synthesis of Ag-ZnO nanocomposites: Characterization, mechanisms, and applications”, in *Zinc-Based Nanostructures for Environmental and Agricultural Applications*, *Elsevier*, USA, November 2021.
- v. J. S. Tamang, S. K. Jha, R.S. Dhar, **S. Chatterjee**, “Detection of Chemical Warfare Agents Using Kretschmann–Raether Configuration-Based Surface Plasmon Resonance (SPR) Biosensor” *Advances in Communication, Devices and Networking. Lecture Notes in Electrical Engineering*, Vol 776. *Springer*, Singapore, 2022.

List of Publications

(h-index: 25 according to Google Scholar 2024)

Journals:

1. **Title:** Defects detection in dentistry: designing a graphene multi-layered based plasmonic sensor
Authors: J. S. Tamang, S. Chatterjee, R. S. Dhar*
Centre for Material Science and Nanotechnology, Sikkim Manipal University, India
*NIT, Mizoram, India
Journal: *Physica Scripta*, IOP-Sciences, *Vol. 98*, p.065605, 2022 (I.F: **2.9**).
2. **Title:** Plasmonic photocatalysis of concentrated industrial LASER dye: Rhodamine 6G
Authors: S. Majumder, **S. Chatterjee**, P. Basnet, J. Mukherjee*
Centre for Material Science and Nanotechnology, Sikkim Manipal University, India
*Laser and Plasma Technology Division, Bhabha Atomic Research Centre, India
Journal: *Journal of Molecular Liquids*, *Elsevier*, *Vol. 358*, p. 119138, 2022 (I.F: **6.1**).
3. **Title:** Cellulosic graphene: growth, characterization, and fabrication toward ambient humidity sensing
Authors: H. Pal, R. Mahapatra*, S. Datta, **S. Chatterjee**

Centre for Material Science and Nanotechnology, Sikkim Manipal University, India

* Dept. E& EC, NIT, Durgapur, India

Journal: Materials and Manufacturing Processes, Taylor & Francis, Vol. 37, p.1850, 2022 (I.F. 4.8)

4. **Title:** Review on Efficiency Enhancement using Natural Extract Mediated Dye Sensitized Solar Cell for Sustainable Photovoltaics

Authors: A. Bist and S. Chatterjee

Centre for Material Science and Nanotechnology, Sikkim Manipal University, India

Journal: *Energy Technology*, Wiley, Vol. 9 (8), p. 2001058, 2021 (I.F: 3.5).

5. **Title:** Proficient Route in Synthesis of Glucose Stabilized Ag Modified ZnS Nanospheres for Mechanistic Understandings of Commercially used Dyes Degradation

Authors: D. Samanta, P. Basnet, S. Jha, S. Chatterjee

Centre for Material Science and Nanotechnology, Sikkim Manipal University, India

Journal: *Inorganic Chemistry Communications, Elsevier, Vol. 141, p.109498, 2021 (I.F: 3.8).*

6. **Title:** Visible Light Facilitated Degradation of Alternate Dye Solutions by Highly Reusable Mn-ZnO Nano-photocatalyst

Authors: P. Basnet, D. Samanta, I. Chanu, and S. Chatterjee

Centre for Material Science and Nanotechnology, Sikkim Manipal University, India

Journal: *Journal of Alloys and Compounds, Elsevier, Vol. 867, 5 p. 158870, 2021 (I.F: 5.316).*

7. **Title:** Laser surface texturing on Ti-6Al-4V

Authors: I. Shivakoti¹, G. Kibria², S. Das¹, A. Sharma¹, B. Pradhan¹, and S. Chatterjee³

¹Department of Mechanical Engineering, Sikkim Manipal Institute of Technology,

²Department of Mechanical Engineering, Aliah University, Kolkata, India.

³Centre for Material Science and Nanotechnology, Sikkim Manipal University, India

Journal: Materials and Manufacturing Processes, Taylor & Francis, Vol. 36, 7 P. 858-867, 2021 (I.F. 4.61).

8. **Title:** Synergistic Effect of Tea-Phytochemicals, Noble Metals and ZnO Nano-Photo-Composites for Combating Resistance of Bacterial Growth

Authors: P. Basnet¹, P. K. Jha¹, A. Gupta², **S. Chatterjee**¹

¹Centre for Material Science and Nanotechnology, Sikkim Manipal University, India

²Department of Pathology, Sikkim Manipal University, Sikkim, India

Journal: Journal of Nano Research, Scientific. Net, Vol.70, 2021 (I.F. **1. 24**).

9. Title: Bio-sensing application of chalcogenide thin film in a graphene-based surface plasmon resonance (SPR) sensor

Authors: J. S. Tamang, R. S. Dhar*, A. K. Bhoi, A. K. Singh, **S. Chatterjee**

Centre for Material Science and Nanotechnology, Sikkim Manipal University, India

*National Institute of Technology, Mizoram, India

Journal: Sādhanā, *Springer*, Vol.46, 3, p.1-10, 2021 (I.F: 0.85).

10. Title: Chemical Approach Based ZnS-ZnO Nanocomposite Synthesis and Assessment of their Structural, Morphological and Photocatalytic Properties

Authors: P. Basnet, D. Samanta, and **S. Chatterjee**

Centre for Material Science and Nanotechnology, Sikkim Manipal University, India

Journal: J. Nano- Electron. Phys. Vol. 13 No 1, p.01025, 2021. (I.F.: 0.8).

11. Title: ZnO based Nanomaterials for Photocatalytic degradation of Aqueous Pharmaceutical Waste Solutions- A Contemporary Review

Authors: S. Majumder, **S. Chatterjee**, P. Basnet, J. Mukherjee

Centre for Material Science and Nanotechnology, Sikkim Manipal University, India

Journal: Environmental Nanotechnology, Monitoring & Management, Elsevier, *Vol. 14, P. 100386*, 2020 (Cite Score: 6.1).

12. Title: Structure-directing property and growth mechanism induced by capping agents in Nanostructured ZnO during hydrothermal synthesis

Authors: P. Basnet and **S. Chatterjee**

Centre for Material Science and Nanotechnology, Sikkim Manipal University, India

Journal: Nano-Structures & Nano-Objects, Elsevier, *Vol. 22, P. 100426*, 2020 (C.S.: 7.8).

- 13. Title:** Biomolecule Assisted Morphology-Controllable Synthesis of Zinc Sulphide Nanomaterials for Efficient Photocatalytic Activity under Solar Irradiation
Authors: D. Samanta, P. Basnet, T. I. Chanu, and **Somenath Chatterjee**
Centre for Material Science and Nanotechnology, Sikkim Manipal University, India
Journal: Journal of Alloys and Compounds, Elsevier, Vol. 844, 5 p. 155810, 2020 (I.F: 5.3).
- 14. Title:** Morphological and Electrical study of P-type Silicon Nanowires synthesized by Ag-assisted Electroless Chemical Etching
Authors: N Chhetri, S. Haldar*, **S. Chatterjee**
Centre for Material Science and Nanotechnology, Sikkim Manipal University, India
* North Bengal University, India
Journal: Materials Research Express, IOP-Sciences, Vol. 6, P. 1250i2, 2020 (*Impact factor:* 1.91).
- 15. Title:** Influence of Design Parameters on Multilayered Nanoplasmonic Structures in Modified Kretschmann-Raether Configurations
Authors: J. S. Tamang, H. Borbora, A. Sutar, R. S. Dhar*, **S. Chatterjee**
Centre for Material Science and Nanotechnology, Sikkim Manipal University, India
* National Institute of Technology, Mizoram, India
Journal: Plasmonics, Springer-Nature, Vol. 15, P. 1133, 2020 (*Impact factor:* 2.33).
- 16. Title:** Glycine-A bio-capping agent for the bioinspired synthesis of nano-zinc oxide photocatalyst
Authors: P. Basnet, D. Samanta, T. I. Chanu, S. Jha, **S. Chatterjee**
Centre for Material Science and Nanotechnology, Sikkim Manipal University, India
Journal: Journal of Materials Science: Materials in Electronics, Springer-Nature, Vol. 31 (4), P. 2949, 2020 (*Impact factor:* 2.47).
- 17. Title:** Computational Method to Obtain the Lifetime of Electrons for Polycrystalline

Silicon Solar Cells

Authors: N Chhetri, and **S. Chatterjee**

Centre for Material Science and Nanotechnology, Sikkim Manipal University, India

Journal: Journal of Nanoscience and Nanotechnology, USA, 20 (6), 3951-55, 2020.
(I.F; 1.354)

18. Title: Reversing and non-reversing effects of PEEK-HA composites on tuning cooling rate during crystallization

Authors: S. K. Dey¹, **S. Chatterjee**², F. Spieckermann, P. Ghosh, S. Samanta

¹Mechanical Engineering Dept., Sikkim Manipal University, India

²North East Regional Institute of Science and Technology (NERIST), India

³Centre for Material Science and Nanotechnology, Sikkim Manipal University, India

⁴Montanuniversität Leoben Austria

⁵Erich Schmid Institute of Materials Science, Leoben Austria

Journal: Journal of Polymer Research, Springer, 26 (12) p. 279, 2019. (I.F: **3.097**)

19. Title: Assessment of synthesis approaches for tuning the photocatalytic property of ZnO nanoparticles

Authors: P. Basnet, D. Samanta, T. I. Chanu, J. Mukherjee*, **S. Chatterjee**

Center for Materials Science and Nanotechnology, Sikkim Manipal Institute of Technology, Sikkim Manipal University, Sikkim-737136, India

*Laser and Plasma Technology Division, Bhabha Atomic Research Centre, Mumbai, India

Journal: SN Applied Sciences, Springer-Nature, 1(6), p. 633, 2019.

20. Title: Tea-phytochemicals functionalized Ag modified ZnO nanocomposites for visible light driven photocatalytic removal of organic water pollutants

Authors: P. Basnet, D. Samanta, T. I. Chanu, J. Mukherjee*, **S. Chatterjee**

Center for Materials Science and Nanotechnology, Sikkim Manipal Institute of Technology, Sikkim Manipal University, Sikkim-737136, India

*Laser and Plasma Technology Division, Bhabha Atomic Research Centre, Mumbai,

India

Journal: Materials Research Express, IOP-Sciences, *Vol. 6, No.8, 2019. (Impact factor: 1.91)*

21. Title: Control of Size and Distribution of Silicon Quantum Dots in Silicon Dielectrics for Solar Cell Application: A Review

Authors: S. Dutta, **S. Chatterjee***, K. Mallem, Y. H. Cho, J. Yi

College of Information and Communication Engineering, Sungkyunkwan University, 2066 Seobu-ro, Jangan-gu, Suwon, Gyeonggi-do 16419, Korea

*Center for Materials Science and Nanotechnology, Sikkim Manipal Institute of Technology, Sikkim Manipal University, Sikkim-737136, India

Journal: Renewable Energy, Elsevier, Vol. 144, pp. 2-14, 2019 [*Impact factor: 8.001*]

22. Title: Near room temperature sensing of nitric oxide using SnO₂/Ni-decorated natural cellulosic graphene nanohybrid film

Authors: S. Gupta Chatterjee, S Dey**, D. Samanta*, S. Santra**, **S. Chatterjee***, P. K. Guha**, A. K. Chakraborty

Center for Materials Science and Nanotechnology, Sikkim Manipal Institute of Technology, Sikkim Manipal University, Sikkim-737136, India

*Carbon Nanotechnology Lab, Department of Physics, and Centre of Excellence in Advanced Materials, National Institute of Technology, Durgapur-713209, India

**Department of Electronics and Electrical Communication Engineering, Indian Institute of Technology, Kharagpur, India

Journal: Journal of Materials Science: Materials in Electronics, Volume 29, Issue 23, pp 20162–20171, 2018. [*Impact factor: 2.47*]

23. Title: A review on bio-synthesized zinc oxide nanoparticles using plant extracts as reductants and stabilizing agents

Authors: Parita Basnet, T Inakhunbi Chanu, Dhruvajyoti Samanta, **Somenath Chatterjee**

Center for Materials Science and Nanotechnology, Sikkim Manipal Institute of

Technology, Sikkim Manipal University, Sikkim-737136, India

Journal: Journal of Photochemistry and Photobiology B: Biology, *Vol. 183, pp. 201-221, 2018. [Impact factor: 6.252]*

24. Title: Quantified Differentiation of Surface Topography for Nano-materials As-Obtained from Atomic Force Microscopy Images

Authors: Mousumi Gupta and **Somenath Chatterjee**^a

Computer Applications Department, Sikkim Manipal Institute of Technology, Sikkim Manipal University, Sikkim 737136

^aCenter for Materials Science and Nanotechnology, Sikkim Manipal Institute of Technology, Sikkim Manipal University, Sikkim-737136, India

Journal: Journal of Materials Engineering and Performance, *Vol. 27, Issue 6, pp 2734–40 2018. [Impact factor: 1.82]*

25. Title: Effect of Grain Boundaries on the Performance of Thin-Film-Based Polycrystalline Silicon Solar Cells: A Numerical Modeling

Authors: Nikita Chhetri and **Somenath Chatterjee**

Center for Materials Science and Nanotechnology, Sikkim Manipal Institute of Technology, Sikkim Manipal University, Sikkim-737136, India

Journal: Journal of Materials Engineering and Performance, *Volume 27, Issue 6, pp 2643–48, 2018. [Impact factor: 1.82]*

26. Title: Synthesis of Flexible Graphene/Polymer Composites for Supercapacitor Applications

Authors: Himangshu Pal, Shuvam Bhubna, Praduman Kumar, Rajat Mahapatra* and **Somenath Chatterjee**

Center for Materials Science and Nanotechnology, Sikkim Manipal Institute of Technology, Sikkim Manipal University, Sikkim, India

*Department of Electronics & Communication, National Institute of Technology, Durgapur, India.

Journal: Journal of Materials Engineering and Performance, *Volume 27, Issue 6, pp*

2668–72, 2018. [Impact factor: 1.82]

27. **Title:** Organic Dye Degradation under Solar Irradiation by Hydrothermally Synthesized ZnS Nanospheres

Authors: D. Samanta, T. Inakhunbi Chanu, P. Basnet, and **S. Chatterjee**

Center for Materials Science and Nanotechnology, Sikkim Manipal Institute of Technology, Sikkim Manipal University, Sikkim-737136, India

Journal: Journal of Materials Engineering and Performance, *Vol. 27, Issue 6, pp. 2673–78, 2018. [Impact factor: 1.82]*

28. **Title:** Effect of Reaction Parameters on Morphology and Photoluminescence of Intrinsic and Mn-doped ZnS Microspheres Synthesized by Hydrothermal Method

Authors: T. Inakhunbi Chanu, D. Samanta, A. Tiwari*, and **S. Chatterjee**

Center for Materials Science and Nanotechnology, Sikkim Manipal Institute of Technology, Sikkim Manipal University, Sikkim-737136, India

*Department of Physics, Sikkim University, Gangtok, Sikkim, India;

Journal: Journal of Materials Engineering and Performance, *Volume 27, Issue 6, pp 2610–16, 2018. [Impact factor: 1.82]*

29. **Title:** Electrical and optical characterization of SiO_xN_y and SiO_2 dielectric layers and rear surface passivation by using $\text{SiO}_2/\text{SiO}_x\text{N}_y$ stack layers with screen printed local Al-BSF for c-Si solar cells

Authors: N. Balaji, H. T. Nguyen, C. Park, M. Ju, J. Raja, **S. Chatterjee***, R. Jeyakumar**, J. Yi

Department of Energy Science, Sungkyunkwan University, Republic of Korea

*Department of Electronics and Communication Engineering, Sikkim Manipal Institute of Technology, Sikkim Manipal University, India

**Physics of Energy Harvesting Division, CSIR-National Physical Laboratory, India

Journal: Current Applied Physics, *18, 107-113 2018. [Impact factor: 2.48]*

30. **Title:** Citrus Limetta Juice as Capping Agent in Hydrothermal Synthesis of ZnS

Nanosphere for Photocatalytic Activity

Authors: D. Samanta, T. I. Chanu and **S Chatterjee**

Centre for Material Science and Nanotechnology, Sikkim Manipal Institute of Technology, Sikkim Manipal University, Sikkim, India

Electronics & Communication Engineering Department, Sikkim Manipal Institute of Technology, Sikkim Manipal University, Sikkim, India-746.

Journal: Materials Research Bulletin, 88, 85-90, 2017. [*Impact factor: 4.641*]

31. Title: Effect of Reaction parameters on Photoluminescence and photocatalytic activity of Zinc sulfide nanosphere synthesized by hydrothermal route

Authors: T. I. Chanu, D. Samanta, A. Tiwari*, **S. Chatterjee**

Center for Materials Science and Nanotechnology, Sikkim Manipal Institute of Technology, Sikkim Manipal University, Sikkim-737136, India

*Sikkim University, Sikkim

Journal: Applied Surface Science, 391, 548-56, 2017 [*Impact factor: 6.707*]

32. Title: Improved Data Retention of InSnZnO Nonvolatile Memory by H₂O₂ Treated Al₂O₃ Tunneling Layer: A Cost-Effective Method

Authors: J. Raja, C. P. T. Nguyen, C. Lee, N. Balaji*, **S. Chatterjee****, K. Jang, H. Kim, J. Yi

College of Information and Communication Engineering, Sungkyunkwan University, Suwon 440-746, South Korea.

*Department of Energy Science, Sungkyunkwan University, Republic of Korea

**Department of Electronics and Communication Engineering, Sikkim Manipal Institute of Technology, Sikkim Manipal University, India

Journal: IEEE Electron Device Letters, 37: 10, pp. 1272-1275, 2016. [*Impact factor: 4.187*]

33. Title: Surface passivation of boron emitters on n-type c-Si solar cells using silicon dioxide and a PECVD silicon oxynitride stack

Authors: N. Balaji, S. Lee, C. Park, J. Raja, H. T. T. Nguyen, **S. Chatterjee***, K.

Nikesh, R Jeyakumar**, J. Yi

Department of Energy Science, Sungkyunkwan University, Republic of Korea

*Department of Electronics and Communication Engineering, Sikkim Manipal Institute of Technology, Sikkim Manipal University, India

**Physics of Energy Harvesting Division, CSIR-National Physical Laboratory, India

Journal: RSC Advances, Vol.6, Issue 74, pp. 70040-45, 2016. [*Impact factor: 3.36*]

34. Title: Graphene–metal oxide nanohybrids for toxic gas sensor: A review

Authors: S. G. Chatterjee, **S. Chatterjee**, A. K. Ray, and A. K. Chakraborty*

Center for Materials Science and Nanotechnology, Sikkim Manipal Institute of Technology, Sikkim Manipal University, Sikkim-737136, India

*Carbon Nanotechnology Lab, Department of Physics, and Centre of Excellence in Advanced Materials, National Institute of Technology, Durgapur-713209, India

Journal: Sensors & Actuators: B. Chemical, Vol. 221, 1170-81, 2015. [I.F.: **7.46**]

35. Title: Improvement of mobility in oxide-based thin film transistors: A brief Review

Authors: J. Raja, K. Jang, C. P.T. Nguyen, J. Yi, N. Balaji, S. Qamar Hussain, **S. Chatterjee***

College of Information and Communication Engineering, Sungkyunkwan University, Suwon 440-746, Korea.

*Department of Electronics and Communication Engineering, Sikkim Manipal Institute of Technology, Sikkim Manipal University, Sikkim 737102, India.

Journal: Trans. on Electrical and Electronic Materials, Vol. 16, No. 5, pp. 234-240, 2015 [I.F.: 0.8].

36. Title: Boosting the mobility and bias stability of oxide-based thin-film transistors with ultra-thin nanocrystalline InSnO: Zr layer

Authors: J. Raja, K. Jang, S. Qamar Hussain, N. Balaji, **S. Chatterjee***, S Velumani, J. Yi

College of Information and Communication Engineering, Sungkyunkwan University, Suwon 440-746, Korea.

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Authors: J. Raja, S. Jung, K. Jang, Z. Jin, **S. Chatterjee***, S Velumani, J. Kim, J. Yi
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Authors: J. Raja, K. Jang, N. Balaji, S. Q. Hussain, S. Velumani, **S. Chatterjee***, T. Kim, J. Yi

College of Information and Communication Engineering, Sungkyunkwan University,
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Authors: A. K. Ray, **S. Chatterjee**, J. K. Singh* and H. Bapari*

Center for Materials Science & Nano Technology, Sikkim Manipal Institute of Technology, Majitar, Sikkim-737136, India.

*Department Corrosion and Surface Engineering, CSIR- National Metallurgical Laboratory, Jamshedpur 831007, India.

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College of Information and Communication Engineering, Sungkyunkwan University,
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Authors: S. Roy¹, S. Biswas, S. Gupta Chatterjee, and **S. Chatterjee**

¹Thin Film Nanotechnology Lab, Chang Gung University, Taoyuan, Taiwan,
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Authors: **S. Chatterjee**¹ and Y. Kuo²
¹Department of Electronics and Communication Engineering, Techno India, India
²Thin Film Nano and Microelectronics Research Laboratory, Texas A&M University, College Station, TX, USA
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Authors: Ö. Tüzün^a, Y. Qiu^b, A. Slaoui^a, I. Gordon^b, C. Maurice^c, S. Venkatachalam^b, **S. Chatterjee**^a, G. Beaucarne^b, J. Poortmans^b
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Authors: **S. Chatterjee**^a, Y. Kuo^b, and J. Lu^b
^a School of Electrical Sciences, Vellore Institute of Technology, TN, Vellore 632014
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Authors: S. Chatterjee^a, and L. K. Bera^b

^a School of Electrical Sciences, Vellore Institute of Technology, Vellore 632014

^b Department of Process Integration, Kedah Darul Aman, Malaysia

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Authors: S. K. Samanta^a, L. K. Bera^b and S. Chatterjee^c

^aMicroelectronics Laboratory, Dept. Electronics & ECE, Indian Institute of Technology, Vellore 632014

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Authors: S. Chatterjee^a, Y. Kuo^a, J. Lu^a, J. -Y. Tewg^a, and P. Majhi^b

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Authors: C. K. Maiti^a, S. K. Samanta^b, **S. Chatterjee**^c, G. K. Dalapati^d, and L. K. Bera^e

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^eInstitute of Microelectronics, Singapore 117685, Singapore

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^cDepartment of Electronic Engineering, Trinity College, University of Dublin, Dublin 2, Ireland

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Authors: C. K. Maiti^a, G. K. Dalapati^a, **S. Chatterjee**^a, S. K. Samanta^a, S. Varma^b and S. Patil^b

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^bInstitute of Physics, Bhubaneswar 751005, India

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Authors: G. K. Dalapati^a, **S. Chatterjee**^a, S. K. Samanta^a, S. K. Nandi^a, P. K. Bose^b, S. Varma^c, S. Patil^c, and C. K. Maiti^a

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^cInstitute of Physics, Bhubaneswar 751005, India

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Authors: G. K. Dalapati, S. K. Samanta, **S. Chatterjee**, P. K. Bose¹, S. Varma², Shivprasad Patil² and C. K. Maiti

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²Institute of Physics, Bhubaneswar 751005, India

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Authors: Y.S. Noh^a, **S. Chatterjee**^b, S. Nandi^b, S.K. Samanta^b, C. K. Maiti^b, S. Maikap^c, W. K. Choi^a
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^cSchool of Material Science and Engineering, Seoul National University, Seoul 151-742, South Korea
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Authors: S. K. Samanta^a, **S. Chatterjee**^a, W. K. Choi^b, L. K. Bera^b, H. D. Banerjee^c,

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^bDepartment of Mechanical Engineering, Jadavpur University, Kolkata 700 032, India

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List of Research & Development / Industrial/Training experiences

Technical Expertise

Device fabrication system:

Thin Film deposition units [MOCVD, ECR PECVD, LPCVD, sputtering (DC/RF), E-beam/Thermal evaporator], Thermal oxidation/diffusion furnace, Rapid Thermal Processing System, Reactive Ion Etching System, Wet Chemical Etching, Photolithography system

Chemical & Physical Characterization system: UV-Vis-NIR Spectroscopy, Raman Spectroscopy, ESCA (XPS & AES), FTIR, RBS, XRD, SEM, AFM & STM, PL measurement, Ellipsometer, Surface profilometer

Electrical Characterization system: Semiconductor testing system (HP4061A Hewlett Packard, USA), Parameter Analyzer (HP 4145B, HP 4140B, and HP 4155C), LCR meter, Automatic prober

Laboratory Experiences

- (i) Maintaining the clean room facilities for photovoltaics research in South Dakota State University, USA
- (ii) Setting up teaching and research laboratories: During stay in Texas A&M University, USA directly involved in design and set up of Clean room facility (Class 100, 1000, 10000) for conducting Micro and Nano-electronics research
- (iii) Conducting laboratory courses: During stay in Vellore Institute of Technology, India the following laboratory experiments are setup and taught among the students:
 - a) To study the input characteristics and find the Trans conductance and threshold voltage for NMOS and PMOS devices using PSpice.
 - b) To study the output characteristics and find the drain current in different regions for NMOS and PMOS devices using PSpice.
 - c) Design CMOS Inverter & CMOS Amplifier using PSpice Software.
 - d) To study the input and output characteristics and find the parameters (Trans conductance and threshold voltage, etc) for PMOS & NMOS devices using CD 4007UB MOSFET Array.
 - e) Construction of Conductive gold thin film on glass plates and measuring the thickness of the gold film using optical microscope as probe.
 - f) Measure the Voltage generation of Piezoelectric crystal with mechanical stress using OP-AMP based amplifier circuits.

- g) To study theoretically the variation of channel charge with applied gate bias in accumulation, depletion and inversion region of advanced CMOS devices
- (iv) Center for Materials Science and Nanotechnology Research Laboratory at SMIT, Sikkim Manipal University: Based on funding as obtained from various Government funding agencies of India, like DST, MeitY, DAE etc. as well as from Institute two different laboratory facilities have been developed, where PhD/PG scholars have been associated with their exciting research outcomes:
- a) Nano-synthesis laboratory: Thin film deposition tools: ECR-PECVD, DC-Sputtering, Spin-coater, furnaces etc. for different kinds of inorganic nanomaterials synthesis
 - b) Nano-characterization laboratory: Different kinds of analysis tools: Surface probe Microscopy (AFM, STM), FTIR spectroscopy, UV-Vis Spectroscopy, Contact angle, Optical microscopy, Solar-cell simulator, 2400 SCS I-V measurement system etc. for characterization of synthesized nanomaterials.

PhD thesis work

I have been actively participated in the development of various processes like oxidation, metallization, photolithography, etching, etc. required for the fabrication of nano-CMOS technology. The title of my Ph.D. work is to study the “**Deposition and Characterization of High-k Gate Dielectric Films on Strained SiGe-Heterolayers**”. New materials development is the enabler of technological breakthroughs, leading to advanced microelectronic devices, continuing miniaturization, conservation of power and reduction in cost. As the MOS scaling process continues to sub-100 nm regime, the gate oxide thickness becomes the major obstacle as leakage current increases exponentially. Conventional silicon dioxide or oxynitride gates need to be replaced with high dielectric constant (high-k) materials. However, finding an alternative for the well-established thermal SiO₂ is a challenging task. The alternative gate dielectric has to meet all the requirements such as thin equivalent oxide thickness, low leakage, high reliability and most importantly the compatibility with Si-processing. Very exciting and promising results from the group-IV hetero-layers have also led to the new silicon-germanium (SiGe) technology based device and circuits which have opened up an entirely new dimension in VLSI/ULSI in Si technology. As the high-k gate dielectrics reduce gate leakage and strained-SiGe enhances the performance of MOSFETs, it would be interesting to combine the both for a solution for future generation nano-CMOS technology. Among several promising high-k candidates (transition

Metal oxides), Ta₂O₅ and ZrO₂ have become important due to their good compatibility with conventional CMOS technologies.

The most versatile technique for growing semiconductor films is the metalorganic chemical vapor deposition (MOCVD) technique (introduced around 30 years back). The MOCVD is basically transport of precursor molecules (group III metalorganics and group V hydrides or alkyls) by a carrier gas H₂ or N₂ onto a heated substrate, and surface chemical reaction occurs. In my study, to deposit different dielectric materials for gate dielectrics (e.g. Ta₂O₅ and ZrO₂) in CMOS application on Si or strained-SiGe substrate, I began with the metalorganic source for precursor i.e. Tantalum penta-ethoxide and Zirconium tetra-tert-butoxide and N₂ or H₂ as carrier gas through mass flow controller (MFC). The saturated vapor on the substrate surface in the reaction chamber was controlled by the carrier gas through the adjustment of MFC. To obtain the desirable vapor pressure (not too low or high) near to the substrate surface during reaction, I modified the reaction chamber with the μ -wave heating source instead of RF heating system.

This dissertation presents the results of a comprehensive study on the high-k film deposition at a low temperature using microwave plasma, the electrical and physical properties of the ultra-thin films and the post-deposition annealing effect. To reach the objective, following studies have been carried out:

- Deposition of ultra-thin films of different composition such as Ta₂O₅, O₂ / Ta₂O₅, NO/ Ta₂O₅, and ZrO₂ directly on strained-SiGe using low temperature microwave PECVD system.
- Compositional analysis and bond structure studies of the films have been performed using various characterization tools.
- Capacitance-voltage, conductance-voltage characteristics, and leakage current mechanism have been studied in detail for determining the electrical properties of the deposited films.
- Effect of annealing on the electrical properties of the deposited films and comparison with the as-deposited films.

Research Accomplishments

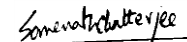
1. Zn based nanomaterials synthesis for photocatalytic application (Published in Journal: *Applied Surface Science*, *Journal of Alloys & Compounds*, *Materials Research Bulletin* & *Journal of Materials Engineering and Performance*, etc).
2. Actively involved to develop new materials for Thin-film transistor, Non-volatile memory applications as well as photo-catalytic degradation for different dyes used in the textile industry (Published in Journal: *IEEE Electron Device Letter* & *Applied Physics Letter*, etc).
3. Modification in Silicon wafer based solar cell to increase the solar cell parameters (Published in Journal: *Solar Energy Materials and Solar Cells*, *Renewable Energy*, *Energy Technology*, *RSC Advances* & *Current Applied Physics*, etc.)
4. Optimized the process conditions (e.g. temperature, thickness, duration, pressure) for formation of doped Poly Silicon seed layers on foreign substrate (e.g. glass or Alumina) by metal induced crystallization (using Aluminium) process for solar cell application.
5. Optimized the process condition for Emitter (homojunction) formation of Solar cell using different doping density, temperature and duration for baking and annealing process.
6. Developed a high temperature DC conductivity measurement set-up to calculate activation energy for thin film (e.g. Amorphous Si, Nanocrystalline Si etc.) deposited on foreign substrate at high and low temperature region.
7. Developed Plasma enhanced **chemical vapor deposition** system using **metalorganic** materials as precursor and microwave plasma as a source to create the ionized state for depositing transition metal oxides on a substrate (Published in Journal: *Solid State Electronics*, *Semiconductor Science and technology* & *Journal of Physics D: Applied Physics*).
8. Studied in detail the performances of different transition metal oxides ($10 < \epsilon_r < 100$) as gate dielectric materials for nano-scale complementary metal-oxide-semiconductor (CMOS) field effect transistor applications. Compatibility and stability of these materials for nanometric CMOS applications were observed based on their chemical, physical and electrical characteristics.
9. Investigated the electrical, chemical behaviors of different high-k gate dielectrics with different underlying substrates, like Bulk Si, Strained SiGe, ZnO/n-Si, Strained SiGeC,

SiC and Strained-Si (the strained epitaxial layer on substrate to enhance the mobility) for advanced MOS device applications. Leakage current mechanisms of MOS devices (e.g. Schottky, Poole-frenkel etc.) and extraction of the different parameters (e.g. dynamic dielectric constant etc.) were calculated in detail.

10. Proposed a method to judge the interface quality of the dielectric/substrate interface with/without buffer layer, using the constraint theory and verified experimentally the density of charge defects present in the layer by electrical measurements. Showed the advantages of using stacked layer based on electrical performance and to enhance the permittivity of MOS capacitors, the nanolaminates structure were proposed.
11. Investigated the performance of electrical as well as chemical characteristics of mixed transition metal oxide layer for nanometric MOS applications and optimized the deposition conditions based on the performances. It is observed that the crystallization temperature of ultrathin transition metal oxides is suppressed by doping of another transition metal in the film.
12. Developed a model to study the change in gate current during stressing by taking into account the density of charge build-up and the charged traps due to electrical stressing for high-k (thickness ~2.5 nm) gate dielectric with metal nitride gate electrode of MOS device. Studied the reliability characteristics of nano-scaled MOS devices with constant voltage/current and high thermal stress.

The information are provided here to the best of undersigned knowledge.

Date: 22/09/2021



Prof. (Dr.) Somenath Chatterjee