SAPAN KUMAR SEN

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EMPLOYMENT

1. **National Institute of Standards and Technology (NIST), Boulder, CO, USA**
   Graduate Research Assistant (GRA): Duration: July 14, 2025 – present
2. **Department of Physics, CU Boulder, Boulder, CO, USA**
   Graduate Teaching Assistant (GTA): Duration: August 15, 2024 – May 15, 2025
3. **Bangladesh Atomic Energy Commission (BAEC), Dhaka, Bangladesh**
   Senior Scientific Officer (Study leave); Duration: June 2021 – present **(Study leave)**
   Scientific Officer (Junior Researcher); Duration: July 2016 - June 2021

EDUCATION

Department of Physics, Jagannath University, Dhaka-1100, Bangladesh. (website)

M.Sc.: Physics (Thesis), CGPA **4.00/** 4.00, **1st position** (published: 17/04/2014), 1 year [July 2009 – July 2010];

B.Sc. (Honors): Physics, CGPA **3.75/**4.00, **3rd position** (published: 21/05/2012,), 4 years [Jun 2005 – Jul 2009]

RESEARCH EXPERIENCE

1) M.Sc. thesis:

Title: The Augmented Space Recursion Study with Spin-Orbit Coupling

- **Brief view:** This is my initial research work into the area of DFT simulations for investigating material properties, considering how spin-orbit coupling influences the electronic structure, density of states (DOS), magnetic moments, and band energies of disordered FeCr alloys,
- **Supervisor:** Professor **Dr. Ain-ul Huda**, Department of Physics, Jagannath University, Dhaka-1100, Bangladesh.

2) MEXT Nuclear Researchers Exchange Program 2020 Fellowship, Japan:

Title: Development of functional nanomaterials for energy and environmental applications using charged-particle beams

- **Brief view:** Synthesis of phosphorus (P)-doped **Ketjen Black/Graphene Oxide (GO)** nanomaterial-based electrocatalysts, utilizing electron beam techniques for potential applications in **fuel cells**.
- **Attended Institution:** Takasaki Advanced Radiation Research Institute (TARRI), National Institute for Quantum and Radiological Science and Technology (QST), Japan
- **Supervisor: Dr. Shunya YAMAMOTO** (Senior Researcher), TARRI, QST, Japan
- **Used techniques:** Electron beam facility, XRD, FESEM, EDS, TEM, FTIR, XPS, Raman, and UV-vis spectroscopy.
- **Duration:** 3rd December 2020 to 17th March 2021 [Website]

3) Research work at BAEC and Collaboration:

Quantum materials synthesis: Hydrothermal synthesis of Carbon Quantum Dots (QDs) (Ongoing)

Thin film growth using spin-coating, spray pyrolysis & chemical vapor deposition (CVD):

- Spin coating growth of Al doped ZnO thin film for optoelectronic & photonic device application;
- Opto-structural properties of spray pyrolysis-deposited CuO & h-MoO_3 films under γ radiation;
- Band gap tuning of spray pyrolysis-deposited Fe^{3+} ions doping on TiO_2 thin films;
- CVD grown and substrate temperature effect on morphology of two dimensional (2D) VS_2 and VSe_2

Hydrothermally grown nanomaterials: shape control, doping & annealing temperature effects:
Physical properties study of pure and Dy-doped α-MoO_3 nanobelts; Ag-doped h-MoO_3 nanorods & α-MoO_3 nanoplates to nanorods; Fe deoped 2D α-MoO_3 sheet treated by annealing temperature; effect of Fe-doping and post annealing temperature of MoO_3 nanosheets; 2D MoS_2 nanosheet.

Materials in extreme environment (Gamma radiation):
- Spray pyrolysis-deposited CuO & h-MoO_3 films; hydrothermal growth of α-MoO_3; sol-gel synthesized h-MoO_3 nanorods; sol–gel auto-combustion synthesized $NiFe_2O_4$ treated by Co-60 gamma (γ) photon

Dye-Sensitized Solar Cell (DSSC) application:
- Growth mesoporous TiO_2 film on ITO substrate for DSSC photoanode application
- TiO_2 photoanode modification by garlic-extracted MnO_2 nanoparticles for DSSC application

Antibacterial activity study of nanomaterials:
- Physical properties and antibacterial activity study of hydrothermally synthesized h-MoO_3 nanorods and α-MoO_3 nanoplates; Sm-doped α-MoO_3 2D-layered nanoplates; Dy-Doped α-MoO_3 nanobelts

Bismuth [BiOX (X= Cl, I, Br)] based Photocatalysts synthesis:
- Hydrothermal synthesis and photocatalytic properties study of TiO_2/SnO_2/BiOCl and TiO_2/ZnO/BiOBr nano-composites
- Surfactants (HNO_3/BiOI/Glacial Acetic acid/PEG/PVP) dependant shape control and photocatalytic properties study of BiOI (Flower, plate, spherical and flake)

Clay/organo-modified magnetic Ferrite:
- Structural, Magnetic and dielectric properties of $NiFe_2O_4$/nanoclay (DDA-MMT), $NiFe_2O_4$/Na-MMT, $CuFe_2O_4$/nanoclay, $MgFe_2O_4$/TBA-MMT nanocomposites synthesized via sol-gel autocombustion. [MMT- Montmorillonite, DDA- Dodecylalkylammonium, TBA- Tertiary butyl alcohol]

Green/bio-synthesis of nanomaterials:
- Hydroxyapatite from egg-shells; $Mg(OH)_2$/MgO from Carambola leaves; BaO from *Moringa Oleifera* leaves; CuO from Mussaenda leaves; ZnO from Syngonium leaves; garlic-extracted MnO_2; Carambola & *Azadirachta indica* leaves-extracted (NiO, Al_2O_3, ZnO, CuO & MgO)

DFT based materials properties simulation:
- Fundamental properties of $CsGeCl_3$ & $CsXBr_3$ (X = Ge/Sn) under pressure; $GaAgO_2$ and $AlAgO_2$

Hands-on experience with techniques/ instruments:
Thermal spray pyrolysis technique (TSPT), Sol-gel spin coating, Chemical Vapor Deposition (CVD), Doctor blade method, Hydrothermal method, Sol-gel, Coprecipitation method, Sol-gel auto combustion method, ^{60}C- γ and e-beam irradiation, Teflon lined hydrothermal autoclave, Laboratory water bath, Hot plate, Magnetic stirrer, Laboratory oven & furnaces

Familiar with other instruments in our lab:
PECVD, LPCVD, Thermal & e-beam evaporator, Solar cell deposition chamber, clean room facility, RTA, Various optical microscopes, lithography tool/ Masking

Materials Characterization Techniques:
X-Ray diffraction (XRD), Scanning electron microscope (SEM), Field emission scanning electron microscopy (FE-SEM), Energy dispersive X-ray (EDX) mapping, Fourier-transform infrared spectroscopy (FTIR), UV-vis-NIR diffuse reflectance spectroscopy (DRS), X-ray photoelectron spectroscopy (XPS), Physical property measurement system (PPMS), Photoluminescence Spectroscopy (PL), Raman spectroscopy, Stylus Profilometers, Four-point probe, Hall Effect measurement system (HEMS), Solar cell laser scribing machine

RESEARCH GRANT

Topic: Hydrothermal synthesis of transition metals oxide-based nanomaterials: Optical and structural properties; **Role:** Co-Investigator; **Host:** Khulna University Research Cell, Khulna-9208, Bangladesh: **Amount: $** 5000; FY: 2018-2019

COMPUTER, LANGUAGE AND SOFTWARE SKILLS

Python (basic), C++, Linux, Windows, COMSOL Multiphysics (basic), CASTEP/WIEN2k (basic), X'pert HighScore/Fullprof suite, VESTA, Latex, Microsoft Office, Adobe illustrator, OriginPro, and ImageJ.

EXTRACURRICULAR ACTIVITIES

Membership: Bangladesh Physical Society (BPS), Bangladesh Electronics and Informatics Society (BEIS), Bangladesh Nano Society (BNS), Bangladesh Atomic Energy Scientist Association (BAESA)

Thesis supervision: 10 graduate (M. Sc) students from various university in Bangladesh

Thesis defense board member: M. Sc thesis examiner of Physics Discipline, Khulna University, Bangladesh

Jagannath University Physics Alumni Association: Founding General Secretary, actively organized scientific events, mentored students in research fundamentals

Panel Judge at Science Festival: Served as a Panel Judge at the- 11th & 13th SGHSC Science Festival, Dhaka, in 2019 & 2022; hosted by the Gregorian Science Club at St. Gregory's High School and College in Dhaka

Reviewer of the journals: Reviewer of some notable journals of publisher: IOP, Nature publishing group, Elsevier, Springer, De Gruyter, Hindawi, IEEE Xplore, etc.

FELLOWSHIP, AWARDS, PARTICIPATION, PUBLICATION SUMMARY AND CITATION

Fellowship: MEXT Nuclear Researchers Exchange Program 2020 Fellowship, Japan

An ICTP Hybrid Meeting: Winter College on Optics: Terahertz Optics and Photonics, 6th – 17th Feb 2023

Publication Summary: Web of Science (SCI/SCIE)/Scopus indexed articles: 37**;** Leading author: **17.**

Google Scholar citation: Total citation: 1420+

Conference participation: Participated several conferences and presented oral talks and posters

PUBLICATIONS (Leading author: 1-17)

1) **Sen, S.K.** ***et al.***, Size-strain distribution analysis from XRD peak profile of (Mg, Fe) co-doped SnO_2 nanoparticles fabricated using chemical co-precipitation route, ***Ceramics International***, 50 (21C), 44038-44055 (2024). https://doi.org/10.1016/j.ceramint.2024.08.254
2) **Sen, S.K.** ***et al.***, Structural modifications of BiOBr nanoplates by electron beam irradiation, ***Phys. Scr.*** 99 (12) 125944 (2024). https://doi.org/ 10.1088/1402-4896/ad8817
3) **Sen, S.K.** ***et al.***, The effects of Mn doping on structural, morphological, and optical properties of hydrothermally synthesized h-MoO_3 nanorods, ***Ceramics International***, 50 (7B), 11565-11574 (2024). https://doi.org/10.1016/j.ceramint.2024.01.057
4) **Sen, S.K.** ***et al.***, Structural modifications of BiOBr nanoplates by electron beam irradiation, ***Physica Scripta***, 99, 125944 (2024). https://doi.org/10.1088/1402-4896/ad8817
5) **Sen, S.K.** ***et al.***, Structural, optical, magnetic, and enhanced antibacterial properties of hydrothermally synthesized Sm-incorporating α-MoO_3 2D-layered nanoplates, ***RSC Adv***. 12, 34584-34600 (2022). https://doi.org/10.1039/D2RA05304G
6) **Sen, S.K.** ***et al.***, Dy-doped MoO_3 nanobelts synthesized via hydrothermal route: Influence of Dy contents on the structural, morphological and optical properties, ***J. Alloys Compd***. 876, 160070 (2021).https://doi.org/10.1016/j.jallcom.2021.160070
7) **Sen, S.K.** ***et al.***, Effect of gamma (γ-) irradiation on the structural, morphological, optical and electrical properties of spray pyrolysis-deposited h-MoO_3 thin films, ***Surfaces and Interfaces*** 17, 100377 (2019). https://doi.org/10.1016/j.surfin.2019.100377
8) **Sen, S.K.** ***et al.***, Estimation of hydrothermally synthesized Iron incorporated 2D-sheet-like α-MoO_3 microstructural and optical parameters treated by annealing temperature, ***Mater. Res. Express*** 7 (9), 95005 (2020). https://doi.org/10.1088/2053-1591/abb4f9

9) **Sen, S.K.** ***et al.***, An investigation of ^{60}Co gamma radiation-induced effects on the properties of nanostructured α-MoO_3 for the application in optoelectronic and photonic devices, ***Opt. Quantum Electron.*** 51 (3), 82 (2019). https://doi.org/10.1007/s11082-019-1797-9
10) **Sen, S.K.** ***et al.***, Characterization and Antibacterial Activity Study of Hydrothermally Synthesized h-MoO_3 Nanorods and α-MoO_3 Nanoplates, ***Bionanoscience*** 9 (4), 873–882 (2019). https://doi.org/10.1007/s12668-019-00671-7
11) **Sen, S.K.** ***et al.***, XRD peak profile and optical properties analysis of Ag doped h-MoO_3 nanorods synthesized via hydrothermal method, ***J. Mater. Sci. Mater. Electron***. 31 (2), 1768–1786 (2019)https://doi.org/10.1007/s10854-019-02694-y
12) **Sen, S.K.** ***et al.***, Influence of total absorbed dose of Co-60 γ-radiation on the properties of h-MoO_3 thin films, ***Thin Solid Films*** 693, 137700 (2020). https://doi.org/10.1016/j.tsf.2019.137700
13) **Sen, S.K.** ***et al.***, Gamma irradiated nanostructured $NiFe_2O_4$: Effect of γ-photon on morphological, structural, optical, and magnetic properties. ***AIP Adv***. 11 (7), 75308 (2021). https://doi.org/10.1063/5.0053985
14) **Sen, S.K.** ***et al.***, Effect of Fe-doping and post annealing temperature on the structural and optical properties of MoO_3 nanosheets, ***J. Mater. Sci. Mater. Electron***. 30 (15), 14355–14367 (2019). https://doi.org/10.1007/s10854-019-01805-z
15) **Sen, S.K.** ***et al.***, Structural and optical properties of sol-gel synthesized h-MoO_3 nanorods treated by gamma radiation, ***Nano Express***, 1 (2020) (2). https://doi.org/10.1088/2632-959X/aba4f8 (Citation-**18**)
16) **Sen, S.K.** ***et al.***, X-ray peak profile analysis of pure and Dy-doped α-MoO_3 nanobelts using Debye-Scherrer, Williamson-Hall and Halder-Wagner methods, ***Adv. Nat. Sci. Nanosci. Nanotechnol***. 11 (2), 25004 (2020). https://doi.org/10.1088/2043-6254/ab8732
17) **Sen, S.K.** ***et al.***, Silver incorporated α-MoO_3 nanoplates to nanorods: Exploring the effects of doping on structural, morphological and optical properties. ***Mater. Today Commun***. 27, 102404 (2021). https://doi.org/10.1016/j.mtcomm.2021.102404
18) Islam, M. R & **Sen, S. K.,** Effect of gamma (γ-) radiation on the opto-structural and morphological properties of green synthesized BaO nanoparticles using Moringa Oleifera leaves. ***Heliyon. 10(4)***, e26350 (2024). https://doi.org/10.1016/j.heliyon.2024.e26350
19) Hossain, M. & **Sen, S. K.,** Effect of substrate temperature on the morphology of chemical vapor deposition grown two-dimensional metallic vanadium diselenide. ***Curr. Appl. Phys.*** 52, 31-36 (2023). https://doi.org/10.1016/j.cap.2023.05.008
20) Sarker, P., **Sen, S.K.** ***et al.***, Effect of gamma irradiation on structural, morphological and optical properties of thermal spray pyrolysis deposited CuO thin film, ***Ceramics International***, 47 (3), 3626-3633 (2020). https://doi.org/10.1016/j.ceramint.2020.09.211
21) Hossain, M. K., Mortuza, A. A., **Sen, S.K.** ***et al.***, A comparative study on the influence of pure anatase and Degussa-P25 TiO_2 nanomaterials on the structural and optical properties of dye sensitized solar cell (DSSC) photoanode, ***Opt. -International J. Light Electron Opt***. 271, 507-516 (2018). https://doi.org/10.1016/j.ijleo.2018.05.032
22) Hossain, M., Qin, B. & **Sen, S. K.,** Chemical Synthesis and Substrate Temperature Effect on Morphology of 2D Vanadium Disulfide. ***Cryst. Res. Technol***. 56 (3), 2000184 (2021). https://doi.org/10.1002/crat.202000184
23) Paul, T. C., Babu, M. H., Podder, J., Dev, B. C., **Sen, S.K.** ***et al.***, Influence of Fe^{3+} ions doping on TiO_2 thin films: Defect generation, d-d transition and band gap tuning for optoelectronic device applications. ***Phys. B Condens. Matter*** 604, 412618 (2021). https://doi.org/10.1016/j.physb.2020.412618
24) Mia, M. N. H., Habiba, U., Pervez, M. F., Kabir, H., Nur, S., Hossen, M. F., **Sen, S.K.** ***et al.***, Investigation of aluminum doping on structural and optical characteristics of sol–gel assisted spin-coated nano-structured zinc oxide thin films. ***Appl. Phys. A Mater. Sci. Process***. 126 (3), 162 (2020). https://doi.org/10.1007/s00339-020-3332-z
25) Islam, M. A., Rahaman, M. Z. & **Sen, S. K.,** A comparative study of hydrostatic pressure treated environmentally friendly perovskites $CsXBr_3$ (X = Ge/Sn) for optoelectronic applications. ***AIP Adv***. 11 (7), 75109 (2021). https://doi.org/10.1063/5.0057287

26) Munshi, M. R., **Sen, S. K**. ***et al.***, Electronic, thermodynamic, optical and photocatalytic properties of $GaAgO_2$ and $AlAgO_2$ compounds scrutinized via a systemic hybrid DFT. ***Comput. Condens. Matter***. 34, e00778 (2023). https://doi.org/10.1016/j.cocom.2022.e00778
27) Islam, M. A., Islam, J., Islam, M. N., **Sen, S. K**. & Hossain, A. K. M. A., Enhanced ductility and optoelectronic properties of environment-friendly $CsGeCl_3$ under pressure. ***AIP Adv***. 11 (4), 45014 (2021). https://doi.org/10.1063/5.0048849
28) Rahaman, M. S., Hasnine, S. M. M., Ahmed, T., Sultana, S., Bhuiyan, M. A. Q., Manir, M. S., Ullah, N., **Sen, S.K.** ***et al.***, Radiation crosslinked polyvinyl alcohol/polyvinyl pyrrolidone/acrylic acid hydrogels: swelling, crosslinking and dye adsorption study. ***Iran. Polym. J.*** *(English Ed.)* 30, 1101–1116 (2021). https://doi.org/10.1007/s13726-021-00949-2
29) Hossain, M.K., Raihan, G.A., Akbar, M.A., Kabir Rubel M.H., Ahmed M. H., Khan M.I., Hossain S., **Sen, S.K.** ***et al.***, Current Applications and Future Potential of Rare Earth Oxides in Sustainable Nuclear, Radiation, and Energy Devices: A Review. ***ACS Appl. Electron. Mater***. 4 (7), 3327–3353 (2022). https://doi.org/10.1021/acsaelm.2c00069
30) Das P., **Sen S. K.** ***et al***, Impact of TiO_2 Nanoparticles on Seed Germination and Growth of Nonabokra Rice, Mortality of Bean Weevil, and Antibacterial and Cytotoxic Activity ***Bionanoscience*** 14, 102–118 (2024). https://doi.org/10.1007/s12668-023-01273-0 S.
31) Baul, T.C. Paul, K. Hoque, M.N.I. Khan, S. Islam, **Sen S.K.** ***et al***, Investigation of the structural, magnetic and dielectric properties of $NiFe_2O_4$/nanoclay composites synthesized via sol-gel autocombustion, ***JMR&T*** 27, 6606-6618 (2023). https://doi.org/10.1016/j.jmrt.2023.11.110
32) Sultana S, Sikder S M M, Rahman N, Sardar M N, **Sen S. K.** et al, Adsorption of Cu (II) ions from aquatic environment using preirradiated Ethylene Tetrafluoroethylene Film, Applied Chemical Engineering 7(1) (2024). https://doi.org/10.24294/ace.v7i1.2234
33) M S Manir, M Z Rana, S Dutta, N F Shamma, M S Alam, **Sen S. K.,** Structural, morphological, and optical properties of flowerlike Sm-doped h-MoO_3 nanorods, ***Mater. Res. Express*** 12 (6) 065003 (2025). https://doi.org/ 10.1088/2053-1591/adde13
34) Islam M R et al, Effects of gamma irradiation on phytochemically synthesized CuO nanoparticles using Mussaenda frondosa leaves and their X-ray crystallographic analysis, ***Journal of Radiation Research and Applied Sciences,*** 18(2), 101458 (2025). https://doi.org/10.1016/j.jrras.2025.101458

CONFERENCE PRESENTATIONS

1) **Sen, S.K. et al.**, Cobalt-60 γ-radiation induced Effects on the Structural, Morphological and Functional Properties of Nanostructured h-MoO_3 Thin Film, *International Conference on Electronics and ICT-2018, 25-26 November, 2018, Dhaka, Bangladesh (Poster)*
2) **Sen, S.K. et al.**, An Investigation of the Properties of Co-60 Gamma Irradiated Orthorhombic Molybdenum Trioxide (α -MoO3) Nanoparticles, *International Conference on Electronics and ICT-2018, 25-26 November, 2018, Dhaka, Bangladesh. (Oral)*
3) **Sen, S.K. et al.**, XRD Peak Profile and Optical Properties Analysis of Ag-doped h-MoO_3 Nanorods Synthesized Via Hydrothermal Method, *National Conference on Electronics and Informatics-2019.4-5 Dec, Dhaka, Bangladesh. (Oral)*

REFERENCES

1) Ain-ul Huda, Ph. D. **[Academic (Thesis) Supervisor],**
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