

Sanjay Upadhyay

G-216, School of Physics and Materials Science, Thapar Institute of Engineering and Technology, Patiala-147004, Punjab; M. No. +91-8868838061

E-mail: bannudsanjay@gmail.com, supadhyay_phd18@thapar.edu

Education

Thapar Institute of Engineering and Technology, (TIET)

Punjab-India

Ph.D. (Thesis Submitted)

2018-2022

Ph.D. Research Title: “Synthesis and Characterization of nanosized Molybdenum Carbide and Molybdenum Selenide for Electrocatalytic Applications”.

Ph.D. Supervisor

Dr. O. P. Pandey

Senior Professor,

School of Physics and Materials Science (SPMS),

Thapar Institute of Engineering and Technology, (TIET)

Kumaun University (KU)

Uttarakhand- India

M.Sc.

2014-2016

Physics (Honors), (61.9% aggregate)

Kumaun University (KU)

Uttarakhand-India

B.Sc.

2011-2014

Physics, Chemistry, Maths (65.6% aggregate)

National Level Exam Qualified

- **GATE (AIR: 1272)**
- **JEST (AIR: 121)**

Employment

Thapar Institute of Engineering and Technology, (TIET)

Punjab- India

Research Scholar

July 2018- Till date

- To carry out the research activities planning and executing the experiments
- Material synthesis
- Analyse and resolve research problems
- Data analysis and interpretation
- Manuscript preparation
- Operate and maintain laboratory equipment
- Budget management
- Mentor post graduate students

(Sponsored by UGC-DAE CSR, Indore, India)

- Data analysis
- Timely reports
- Manuscript drafting
- Training and equipment handling
- Budget management
- Independently handle a group of nearly 30-35 students for tutorial
- Lab assessment
- Design and allotment of new experiments
- Monthly minor and semester major projects
- Evaluation

Research and Training

Research Interests:

Material synthesis: Transition metal carbides, Selenides, Nitrides, Oxides, Hydroxides, Chalcogenides, carbon-based materials and ceramic materials; Heterostructure/hybrid and composite.

Applications: Electrochemistry, Supercapacitors, Batteries, Electrocatalysis, water-splitting, Hydrogen evolution reaction (HER), Oxygen evolution reaction (OER), Oxygen reduction reaction (ORR), Photocatalysis, Waste water treatment, supercapacitors, multi-ion hybrid supercapacitors and Photovoltaic characteristics of oxide heterojunctions.

Research Projects

Project Associate-I (PA) for “Synthesis and characterization of molybdenum carbide nanoparticles for electrochemical applications” (Nov. 2018 and March 2022).

Technical skill (independent operation)

- X-ray Diffractometer
- **Electrochemical Work stations (Biologic SP 300 and VSP 300), Gamry instrument for electrochemistry and corrosion**
- Vibrating sample magnetometer (VSM)
- UV-Visible Reflectance Spectroscopy
- Raman spectroscopy
- Scanning Electron Microscope and Differential Thermal Analysis (DTA)/DSC/TGA
- Handling high temperature furnace and autoclave
- Mechanical alloying (High energy and cryogenic milling)
- Hydrothermal and Solvothermal techniques
- Sol-Gel Techniques and Solid-State Techniques

Technical skills (data execution and analysis)

- Fourier transform infra-red (FTIR) spectroscopy

- FESEM, TEM/HRTEM and STEM
- X-ray photoelectron spectroscopy (XPS)
- Brunauer–Emmett–Teller (BET)
- X-ray Diffraction (XRD)
- Raman Spectroscopy
- Rietveld refinement analysis

Software expertise

X-pert High-score, Fullprof, Axio vision and Image J, XPS peak fit, Origin, Adobe Photoshop, ZSimpWin, CrystBox and EC-lab software.

List of publications

Published Papers (Refereed journals)

1. **S. Upadhyay**, O.P. Pandey, One-pot synthesis of pure phase molybdenum carbide (Mo_2C and MoC) nanoparticles for hydrogen evolution reaction, *Int. J. Hydrogen Energy*. 45 (2020) 27114–27128. <https://doi.org/10.1016/j.ijhydene.2020.07.069>.
2. **S. Upadhyay**, O.P. Pandey, Synthesis of layered 2H-MoSe_2 nanosheets for the high-performance supercapacitor electrode material, *J. Alloys Compd.* (2020) 157522. <https://doi.org/10.1016/j.jallcom.2020.157522>.
3. **S. Upadhyay**, O.P. Pandey, Studies on 2D-molybdenum diselenide (MoSe_2) based electrode materials for supercapacitor and batteries: A critical analysis, *J. Energy Storage*. 40 (2021). <https://doi.org/10.1016/j.est.2021.102809>.
4. **S. Upadhyay**, O.P. Pandey, Review—Synthesis and Electrochemical Applications of Molybdenum Carbide: Recent Progress and Perspectives, *J. Electrochem. Soc.* 169 (2022) 016511. <https://doi.org/10.1149/1945-7111/ac4a52>.
5. **S. Upadhyay**, O.P. Pandey, Synthesis of $\text{Mo}_2\text{C}/\text{MoC}/\text{C}$ nanocomposite for hydrogen evolution reaction, *J. Solid State Electrochem.* (2021). <https://doi.org/10.1007/s10008-021-05096-5>.
6. **S. Upadhyay**, O.P. Pandey, Effect of Se content on the oxygen evolution reaction activity and capacitive performance of MoSe_2 nanoflakes, *Electrochim. Acta*. 412 (2022) 140109. <https://doi.org/10.1016/j.electacta.2022.140109>.

Book Chapters

1. Rameez Ahmad Mir, **Sanjay Upadhyay** and O. P. Pandey, “*2D Materials for CO_2 reduction and H_2 production*”, *Advances for Sustainable Environment and Energy: Theory, Status, and Challenges*, WILEY, 2022 (Under review)

Under consideration (in referred journals)

1. S. Upadhyay, O.P. Pandey, “Low-temperature synthesized Mo₂C and novel Mo₂C-MnO₂ heterostructure for highly efficient hydrogen evolution reaction and high-performance capacitors” J. of Power Sources, (*Accepted*)
2. S. Saraswat, R.A. Mir, N. Kaur, **S. Upadhyay** and O. P. Pandey, “Electrochemical pseudocapacitor behavior of BiMoO₆ nano structures” (*Under consideration*).
3. R.A. Mir, S. Upadhyay, O.P. Pandey, Single-step in-situ synthesis of MoO₂ faceted structures as highly efficient HER electrocatalyst and electrode material for pseudocapacitors, Energy Advances (*Under review*).
4. Smriti, R. Priya, D. Kumar, **S. Upadhyay**, O.P. Pandey, Structural and luminescent studies of titanium co-doped SrY₂O₄:Eu phosphors, The Journal of Biological and Chemical Luminescence, (*Under review*).
5. R.A. Mir, **S Upadhyay**, N. Kaur, and O. P. Pandey, Mo₂C-MoS₂ heterojunction a suitable and stable electrocatalyst for HER and Supercapacitor applications, (*Accepted*)
6. R.A. Mir, **S Upadhyay**, R.A. Rather, S. J. Thorpe, and O. P. Pandey , “Single-step in-situ synthesis of MoO₂ faceted structures as highly efficient HER electrocatalyst and electrode material for pseudocapacitors” (*Under review*).
7. P. Sharma, S. Kainth, R. Choudhary, **S. Upadhyay**, P. Bajaj, L.K. Brar, O.P. Pandey, Non-isothermal solid-state synthesis kinetics of the tetragonal barium titanate (*Under consideration*).

Papers presented in national/international conferences

1. **S. Upadhyay** and OP Pandey, One step synthesis of molybdenum carbide nanoparticles for efficient hydrogen evolution reaction, Science, Technology and Emerging Applications of Microscopy (STEAM-2019), *Dr Bhimrao Ambedkar university, Agra, 11-12 Nov. 2019*.
2. **S. Upadhyay** and OP Pandey, Synthesis and characterisation of molybdenum diselenide for photocatalytic degradation of organic dyes, 8th International Selenium Conference (Se2019), *Thapar Institute of Engineering and Technology, Patiala, 20-23 Nov. 2019*.
3. **S. Upadhyay** and O.P. Pandey, Shaping the Energy Future: Challenges and Opportunities (SEFCO 2020), 4th National Symposium SEFCO-2020, organized by *CSIR-Indian Institute of Petroleum, June 5, 2020*.
4. **S. Upadhyay** and O.P. Pandey, Synthesis of Mo₂C/MoC/C nanocomposite for hydrogen evolution reaction, National E-conference on advanced research in materials science, *Kamaraj College, Tamilnadu, 22-23 Feb. 2021*.
5. **S. Upadhyay**, R. A. Mir, and O.P. Pandey, Two-Dimensional Molybdenum Selenide Nanosheets as Efficient Electrode Materials for Supercapacitors, RAFAS 2021, *LPU Punjab, 25-26 June 2021*.
6. R.A. Mir, **S. Upadhyay** and O.P. Pandey, Mo₂C-MoS₂ heterojunction a suitable and stable electrocatalyst for HER and supercapacitor applications, RAFAS 2021, *LPU Punjab, 25-26 June 2021*.
7. **S. Upadhyay** and O.P. Pandey, One-pot synthesis of molybdenum carbide nanoparticles for hydrogen evolution reaction, International Conference on Energy and Advanced Materials (ICEAM)-2021, *IIIT Noida UP. October 21-23, 2021*.

8. **S. Upadhyay** and OP Pandey, EF4 conference, One step synthesis of molybdenum carbide nanoparticles for efficient hydrogen evolution reaction, *School of Chemical Engineering, UNSW AUSTRALIA UNSW SYDNEY NSW 2052 AUSTRALIA, Oct. 18-20, 2021.*

Workshops/ Winter-schools / Seminars / FDP

1. **S. Upadhyay** and O.P. Pandey, Online workshop on Rietveld refinement, UGC-DAE consortium for scientific research, Sep. 22-24, 2020 (*Attended*).
2. **S. Upadhyay** and O.P. Pandey, Advances in corrosion engineering and electrochemical characterization technique, Short term training program, NIT Raipur, 2-6 Jan. 2021 (*Attended*).
3. **S. Upadhyay**, FDP on "Manufacturing and Characterization of 3D Printed Materials (MC3DPM-2021)" from 13/12/2021 to 17/12/2021 at Sant Longowal Institute of Engineering and Technology, Longowal (*Attended*).
4. **S. Upadhyay** and OP Pandey, Synthesis of Mo₂C/MoC/C composite for hydrogen evolution reaction, International Winter School on Frontiers in Materials Science (A Hybrid event) held at Jawaharlal Nehru Centre for Advanced Scientific Research during December 06-10, 2021 (*Participated*).
5. **S. Upadhyay** and OP Pandey, National Seminar on Advanced Functional Materials, Department of Applied Science, MAIT and DRDO, Febuary 24-25th 2022 (*Attended*).
6. **S. Upadhyay** and OP Pandey, National Webinar on "Green Chemistry for Sustainable Future, JM Patel, Bhandara Jan. 21-22, 2022 (*Attended*).
7. **S. Upadhyay** and OP Pandey, #RSCBatteries poster Twitter conference, Dec. 7-8, 2021 (*Participated*).