Dr. PRANJALI SHARMA

ASSISTANT PROFESSOR AT INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

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OBJECTIVE

To pursue a challenging career as a scientist in the field of sustainaibility, decarbonization, and facilitate renewable transition via hydrogen and electrification. I work on analyzing solutions for hydrogen storage, transportation, and distribution and developing advanced materials and to determine their structural-property-performance relationship for meeting performance requirements without compromising with safety at reduced costs. I have extensively worked with fiber-reinforced polymer or other composite structures as fuel storage solutions to meet future energy demands with greener fuels and to cater to the needs of the global scientific community in process development. In the long run, I am looking forward to meaningful associations with organizations and institutions to leverage my research and development skills.

FIELD OF SPECIALIZATION

→ **Lightweight storage tanks:** *Compressed hydrogen gas, compressed natural gas, biogas cylinders compliant with the Indian markets*

→ **Strategy and planning for industrial decarbonization:** *Techno-economic sizing of power production, energy conversion, and energy storage systems for higher industrial capacity utilization especially for fertilizer, refinery, steel, city gas, and mobility sectors*

→ **Recycling of fiber-reinforced composites:** *Sustainably extract fibers from aged composites for reuse in other applications*

→ **Engineering for composite property prediction**- *Fiber volume fraction and structural distribution of filament wound composites*

→ **Finite element analysis**- *Multilevel mechanics for predicting elastic properties, ply-wise failure characteristics, theoretical burst pressure, and fracture mechanics under static loads*

→ **Performance enhancement for the Indian market**- *Thermomechanical analysis to study effect of operation at elevated temperatures on hoop strength, burst pressure, and failure characteristics of composite cylinders utilized in tropical countries*

→ **Testing and Certication-** *Manufacturing and testing of Type-3/Type-4 composite cylinders for onboard hydrogen/ CNG storage in automotive applications following ISO 15869/11439 and other international standards.*

→ **Designing multiple element gas containers-** *Design composite cylinders for efficient bulk hydrogen storage and transport in cascades*

EXPERIENCE

Assistant Professor | Hydro and Renewable Energy Department | Indian Institute of Technologgy Roorkee

Research and development of solutions relating to compressed gas storage cylinders, cryo-compressed hydrogen gas tanks, metal hydride based- hydrogen storage tanks, recycling glass/ carbon fibres from tanks to manufacture wind blades, CNG/ H_2 pipelines, and more. Geological H_2 production and storage with CO_2 sequestration, Real time optimizer and management of green energy systems, strategy and planning for sizing of green power production, energy conversion, and energy storage for maximum capacity utilization for decarbonizing refineries, steel, fertilizer, mobility, and city gas sectors.

Senior Manager | Reliance Industries Limited

Logistics and supply chain technologist for the core team of the hydrogen GIGA Complex. Investigating effect of cylinder design and refueling conditions on net hydrogen storage capacity. Techno-commercial analysis of various hydrogen storage techniques, strategy, and planning for reducing levelized cost of hydrogen storage and transport.

Scientist | Humble Hydrogen Private Limited

Design and development of type-3 and type-4 cylinders for compressed hydrogen gas storage at 350, 500, 700, and 1000 bar. Developing cascades for stacking these cylinders for higher net hydrogen carrying capacities

EDUCATION

Ph.D. | Indian Institute of Technology Kharagpur *July'18 – September'23*

Dissertation: *Filament Wound Composite Pressure Vessels for Energy Storage*

B.Tech | Indian Institute of Technology Patna *July'14 – May'18*

Thesis: *Photophysics of Styryl Derivatives in different Macrocyclic Hosts: A spectroscopic study*

RESEARCH INTERESTS

- **Materials, design, and manufacturing of filament wound FRP composite structures**- *Configuring filament winding machine to manufacture fiber-reinforced polymer matrix composite structures of a given design, geometry, volume, and performance characteristics*
- **Property-based additive manufacturing**- *Determination of composite characteristics in the presence of fillers for strength enhancement, flame retardancy, thermal insulation, adhesion, better weight performance, etc.*
- **Cryo-compressed hydrogen energy storage composite cylinders-** *Design, material, and manufacturing of composite materials suitable to function as cryo-compressed hydrogen storage solutions for cryo-temperature operation*
- **Advanced composite cylinders for thermolysis-assisted chemical hydrogen storage**- *Develop lightweight composites for safe operation at extreme temperature loading conditions for chemical hydrogen storage cylinders*
- **System design and refuelling characteristics for enhanced safety**- *Geometry and raw material modification of FRP composite cylinders and cascades for safe, fast, and low cost hydrogen refuelling and storage.*
- **Geological H_2 production and storage:** *Lab-scale production of hydrogen from iron-rich rocks followed theoretical analysis for feasibility of sub-surface production and storage*
- **Real time optimizer and green energy management systems**- *Operation and control of electrolyzers for round the clock low-cost and efficient green hydrogen production.*

RESEARCH SKILLS

- **Material characterization-** *Expertise in analyzing material characterization data obtained from different characterization techniques, like, as FESEM, NMR, FTIR, TGA, UV-Spectrophotometer, DSC, DMTA, Rheometer, Fluoromax-4P spectrofluorometer, and time-resolved fluorescence spectrophotometer*
- **Instrument handling**- *Hands-on experience with instruments, like, FTIR, TGA, UV-Spectrophotometer, DSC, DMTA, Fluoromax-4P spectrofluorometer, time-resolved fluorescence spectrophotometer, pycnometer, column chromatography, rotary evaporator, etc.*
- **Composite manufacturing**- *Expertise in manufacturing fiber-reinforced polymer matrix composites using hand lay-up, VARTM, filament winding, and compression molding techniques.*
- **Composite coupon testing**- *Experience in mechanical testing of composite coupons using the universal testing machine, Charpy/Izod impact testers, and many other mechanical testing instruments for measuring loss on ignition, heat distortion temperature, Barcol hardness, smoke density, flame retardancy, etc.*
- **Cylinder performance testing**- *In-detail knowledge about the requirements of the performance tests on composite cylinders per testing procedures mentioned in the ISO standards for onboard energy storage*
- **Theoretical analysis-** *Structural mechnicals using finite element methods, developing physics based digital twins for process optimization using excel based tools*

LIST OF PUBLICATIONS

1. **Sharma, P., Burolia, A.K., Adak, N.C., Daiya, J., Sardar, H.H. and Neogi, S. (IF-6.4)**
   "Effect of tension on liner buckling and performance of a type-4 cylinder for storage of compressed gases with experimental validation" Thin-Walled Structures (2023), 189, p.110928.
2. **Sharma, P., & Neogi, S. (IF- 6.3)**
   "Performance-based Design and Manufacturing of Filament Wound Type-4 Composite Pressure Vessels for Compressed Gas Storage" Composite Structures (2023): 116710
3. **Adak, N., Sharma, P., Sardar, H., &Neogi, S. (IF-2.3)**
   "Model verification and determination of temperature-dependent mechanical deformations of short GF/VE composite using laser extensometer" Journal of Materials Engineering and Performance (2022): 1-9
4. **Sharma, P., Sardar, H. H., & Neogi, S. (IF-9.4)**
   "Thermomechanical processing of Type-4 composite cylinders under static load "
   Journal of Energy Storage (2022): 55, 105465
5. **Sharma, P., Sharma, S., Bera, T., Semwal, K., Badhe, R. M., Sharma, A., & Neogi, S. (IF-6.3)**
   "Effects of dome shape on burst and weight performance of a type-3 composite pressure vessel for storage of compressed hydrogen" Composite Structures(2022): 293, 115732
6. **Sharma, P., Chugh, P., & Neogi, S. (IF-3)**
   "Study to methodize the design of a safe Type-4 CNG storage vessel using finite element analysis with experimental validation" International Journal of Pressure Vessels and Piping(2021): 104425
7. **Sharma, P., Bera, T., Semwal, K., Badhe, R. M., Sharma, A., Ramakumar, S. S. V., & Neogi, S. (IF- 7.2)**
   "Theoretical analysis of design of filament wound type 3 composite cylinder for the storage of compressed hydrogen gas" International Journal of Hydrogen Energy(2020): 45(46), 25386-25397

8. **Ahmed, S. A., Gautam, R. K., Sharma, P., Seth, D. (IF-4.3)**
"Photophysics of a Molecular Rotor inside the Block Copolymers"
Journal of Photochemistry and Photobiology A: Chemistry(2017): 351, 170-178

PATENTS

Sharma, P., Bera, T., Semwal, K., Badhe, R. M., Sharma, A., Ramakumar, S. S. V., & Neogi, S.
Development of High Performing Type 3 Composite Cylinders for Compressed Hydrogen Gas Storage. Indian patent (complete specification has been filed with the Indian Patent Office with application number 202221004254

Semwal, K., Sharma, P., Bera, T., Badhe, R. M., Sharma, A., Neogi, S., Singh, G.K., & Ramakumar, S. S. V.
Pressure Vessel for Storing Fluid. US patent (complete specification has been filed with the US Patent Office with application number US20230235854A1

BOOK CHAPTERS

1. **Sharma, P., Burolia, A., Mondal, A., Neogi, S.**
"Commercially available resources for Physical Hydrogen storage, distribution, and utilization in liquid and gaseous form" Towards Hydrogen Infrastructure, Jaiswal-Nagar D., Elsevier

CONFERENCES

April 2024

Type 4 COPV Hydrogen Cylinder Manuafcturing Workshop (IIT Gandhinagar)
Keynote speaker for lectures on design COPVs, and testing/ inspection of hydrogen cylinders

February 2024

International Chemical Engineering Conference on Energy, Environment and Sustainability (ICECEES-2024- IIT Roorkee)
Delegate from Reliance Industries Limited

August 2023

Master Class on Hydrogen Technology, Application and Economics (IESD- Delhi)
Delivered guest lectures on following topics:
1. Challenges in Hydrogen Storage, Distribution and transportation.
2. Safety Aspects in Hydrogen storage and Safety Standards

March 2023

Hydrogen lecture series organized by IESD:
Optimization of Cost in Hydrogen Value Chain

September 2020

European Conference on Composite Materials - (ECCM19)
Effects of Dome Shape on Burst Performance of a Composite Pressure Vessel (Virtual)

December 2019

8th International Hydrogen and Fuel Cell Conference (IHFC-2019)
Guest speaker representing IOCL for study: Theoretical analysis of design of Type 3 Composite Cylinder

ACADEMIC ROLES, AWARDS, AND HONORS

- *Globally recognized as **top 10 women under "Technology and Innovation"** in **2024 Women in Hydrogen 50** by Hydrogen Economist.*
- *Awarded the **Lovraj Kumar Memorial Best Thesis Award** for the year 2023.*
- *Awarded **Prime Minister Research Fellowship**- 2019 (Cleared a national level interview examination and chosen one out of five research scholars from chemical engineering for the year 2019)*
- *3rd position in **Human Power Vehicle Challenge, ASME**'17 (LMNIIT, Jaipur)*
- *Qualified Indian Institute of Technology / **Joint Entrance Examination (IIT–JEE)**-2014, India.*
- ***Academic excellence award** in class XII-2014, State level (CBSE)*
- ***National Science Olympiad**-2012, School rank 1st, state rank 13th, international rank 249th*
- ***Academic Excellence** in class X-2012, State level (CBSE)*

COLLABORATIVE/SPONSORED PROJECTS AND TEACHING EXPERIENCE

- *Development of **low cost hybrid cylinders for CNG storage in heavy duty applications at 250 bar** in collaboration with CNC Technics.*
- *Development of **mobile cascades and composite cylinders for bulk hydrogen storage at 500 bar** at Humble Hydrogen Pvt. Ltd.*
- *Single-handedly started the **hydrogen program** at IIT Kharagpur in collaboration with the R&D Center of Indian Oil Corporation Limited to develop type-3 composite cylinders for onboard hydrogen storage under the National Hydrogen Mission-2019-22*
- *Primary contact point in industrial collaborative projects with my supervisor as the principal investigator on **Performance-based design, manufacturing, and testing** of FRP composite structures for structural applications such as:*
    1. *Type-4 carbon fiber reinforced CNG cylinders for CNC Technics(India)-2022*

2. *Carbon fiber reinforced telescopic tubes for Centillion Solutions(USA)-2022*
3. *Type-4 glass fiber reinforced CNG cylinders for CNC Technics(India)-2021*
4. *Engine hood composite material for Tata Hitachi(India)-2019*
5. *Secondary support in the development of Type-4 CNG cylinders for Gas Authority of India Limited(India)- 2014-19*
6. *Secondary support in Plasma treatment of silica beads for improved adhesion with polymer matrixes for CSP Plastics(USA)*

- ***Mentored** three postgraduate students, each had a publication by the end of their M.Tech project*
- ***Mentored** four undergraduate students*
- ***PMRF teaching assistant** of an NPTEL course on, "Introduction to Composites" under Prof. Nachiket Tiwari*
- ***Institute teaching assistant** for:*
  1. *Mass transfer laboratory*
  2. *M.Tech laboratories*
  3. *Chemical Engineering Principles in Polymer Processing*
  4. *Manufacturing & Characterisation of Polymer Matrix Composites*

COMPUTATIONAL SKILLS

Operating Systems – Windows, Ubuntu

Softwares – ANSYS (Structural dynamics, ACP Pre-post, Fluent) ABAQUS, RHINO, AUTOCAD, SOLIDWORKS, CADFIL, ChemDraw, Origin, Photoshop, Paint-3D, MS-Office

POSITION OF RESPONSIBILITIES

- *Hospitality Cordinator, Anwesha'17*
- *Women's Coordinator, Infinito'17*
- *Hospitality Subcordinator, Anwesha'16*
- *Marketing Head of Bihar, Edumorph*
- *Captain, Basketball Women's team, Inter IIT Sports Meet'17*
- *Captain, Badminton Women's team, Inter IIT Sports Meet'16*
- *Organiser,Verve,Anwesha'15*

LINGUISTIC SKILLS

English, Hindi- Fluent

French, German– Limited Business Proficiency

PERSONAL DATA

Gender: Female
Marital status: Unmarried

Nationality: Indian
Date of birth: 01-12-1996

REFERENCES

Prof. Swati Neogi (Supervisor)
Research area: Hydrogen Storage and Distributions, Reliability of Advanced composites, Advanced Composite Technology, Hybrid Armor, and TPS for hypersonic vehicles
Indian Institute of Technology Kharagpur,
WB, India-721302
Email: swati@che.iitkgp.ac.in

Prof. Sirshendu De (Doctoral Scrutiny Committee Member) (INAE, Institute Chair Professor, Shanti Swarup Bhatnagar Prize)
Research area: Catalysis, Membrane Separation, Transport phenomena
Indian Institute of Technology Kharagpur,
WB, India-721302
Email: sde@che.iitkgp.ac.in

Prof. Debabrata Seth (B.Tech Project Supervisor)
Research area: Photophysics, Chemical Dynamics, Ionic liquids
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