Jui Subhash Junnarkar

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EDUCATION

Rice University, Houston, TX — Expected May 2026
Ph.D., Chemical and Biomolecular Engineering — *Advisor:* Prof. Matteo Pasquali
Dissertation: Transport Phenomena and Reactor Engineering for Scalable Carbon Nanotube Synthesis via Floating Catalyst Chemical Vapor Deposition

BITS Pilani, Goa, India — May 2021
B.E. (Hons.), Chemical Engineering

RESEARCH INTERESTS

Nanomanufacturing: Carbon nanotube synthesis and scale-up; Floating catalyst chemical vapor deposition (FCCVD); Plasma-aerosol nanoparticle engineering; Reactor design.
Computational Modeling: Computational fluid dynamics (CFD); Multiphysics simulations; Artificial intelligence and machine learning for process optimization; Physics-informed neural networks (PINNs).

RESEARCH EXPERIENCE

Doctoral Candidate & Research Assistant, Pasquali Lab, Rice University — Fall 2021 to Present

- Designed and commissioned a deep-injection FCCVD reactor, establishing a hardware platform that more than doubled baseline carbon conversion yield (from 5% to 13%) and enabled subsequent team breakthroughs to 30%.
- Developed validated multiphysics models (COMSOL, OpenFOAM) coupling thermal-fluid dynamics, gas-phase kinetics, and aerosol transport for reacting flows above 1000°C.
- Performed modal stability analysis on linearized Navier-Stokes equations to predict flow transitions, directly informing hardware modifications that widened the stable operating window.
- Engineered an inductively coupled plasma (ICP) system for controlled iron catalyst generation, utilizing real-time OES diagnostics to map nanoparticle nucleation pathways.
- Applied physics-informed neural networks (PINNs) to approximate velocity and thermal fields in reacting flows, enabling rapid design-space exploration at a fraction of CFD computational costs.
- Built Python-based computer vision tools (OpenCV, scikit-image) for automated TEM particle size analysis with statistical distribution fitting.
- Directed a six-institution research collaboration, managing cross-functional workflows to advance high-temperature reactor safety and performance.

PUBLICATIONS

Peer-Reviewed Journal Articles & Conference Papers

1. **Junnarkar, J. S.**, Li, M., Sloan, A. W. N., Khabushev, E., Benavides-Figueroa, A. V., Gong, M. L., Garza, M., Khoury, J. F., Cavuto, D., Williams, S. M., Micale, D., Bracconi, M., Maestri, M., Irvin Jr., G. C., & Pasquali, M. (2025). Understanding the effect of transport phenomena in deep-injection floating catalyst chemical vapor deposition carbon nanotube synthesis. *Carbon*, 238, 120259. doi:10.1016/j.carbon.2025.120259

2. **Junnarkar, J. S.**, Faruquee, T. A., Wang, J., Khabushev, E., Hogan, C. J., Pasquali, M., & Simeni, M. S. (2025). Optical diagnostics investigating iron nanoparticle formation using an inductively coupled plasma. *AIAA SciTech 2025 Forum*. doi:10.2514/6.2025-1177

3. Gong, M. L., Khabushev, E., Benavides-Figueroa, A. V., Sloan, A. W. N., **Junnarkar, J. S.**, Khoury, J. F., Li, M., Irvin Jr., G. C., & Pasquali, M. (2025). Applying acoustic sensing technology to measure and control input precursor vapors in FCCVD systems. *Chemical Engineering Journal*, 524, 169461.

4. Tiwari, U., Ganesan, N. G., **Junnarkar, J. S.**, & Rangarajan, V. (2020). Toward the formulation of bio-cosmetic nanoemulsions: from plant-derived to microbial-derived ingredients. *J. Dispersion Sci. Technol.*, 43(7), 1061-1078.

Manuscripts in Preparation

- Comparison of Vertical and Horizontal FCCVD Reactors for High-Quality CNT Synthesis.
- Deep Jet Injection of Plasma-Generated Catalyst Aerosols for High-Yield CNT Synthesis.
- Hydrodynamic Stability in Confined Reactor Flows: Implications for Carbon Nanotube Synthesis.

CONFERENCE PRESENTATIONS

- **Junnarkar, J. S.** (Oral). "Catalyst Nanoparticle Generation in FCCVD CNT Synthesis." AIChE Annual Meeting 2023, Orlando, FL.
- **Junnarkar, J. S.** (Poster). "Catalyst Nanoparticle Generation Routes for Deep Injection FCCVD." NT'24, Boston, MA, June 2024.
- **Junnarkar, J. S.** (Poster). "Scalable FCCVD Synthesis of High-Purity CNTs." Carbon Hub Annual Meeting 2024, Houston, TX, May 2024.
- Faruquee, T. A., **Junnarkar, J. S.**, Bronikowski, M., Dannar, A., Reece, C., Hogan, C., Pasquali, M., & Simeni, M. S. (Oral). "Insights from OES in a Floating Catalyst CVD CNT Reactor." AIAA SciTech 2026, Orlando, FL, Jan 2026.

TECHNICAL SKILLS

- **Experimental Systems:** CVD, FCCVD, ICP plasma reactors, vacuum systems, high-temperature thermal management, aerosol nanoparticle synthesis
- **Characterization:** Raman spectroscopy, SEM/EDS, TEM, OES, TGA, mass spectrometry, particle sizing (DMA/CPC)
- **Simulation:** COMSOL Multiphysics, OpenFOAM, CFD, FEA, conjugate heat transfer, gas-phase kinetics
- **Programming & AI:** Python (NumPy, SciPy, Pandas, PyTorch, scikit-learn, OpenCV), MATLAB, PINNs, HPC clusters
- **Design & Documentation:** AutoCAD, DoE/statistical analysis, technical writing

AWARDS & FELLOWSHIPS

- **Shell Carbon Hub Fellow**, Rice University (2023 to 2024). *Awarded to top scholars advancing scalable, sustainable carbon materials research.*

LEADERSHIP & MENTORSHIP

- Trained graduate researchers in high-temperature reactor operation, and simulation methodologies, actively accelerating laboratory scientific output.
- Mentored 10 undergraduate engineering students for a national design competition at IIT Bombay Techfest 2018, competing against over 150 teams.
- Led 25-member university team (UNIFY Dance Team, BITS Goa), managing logistics and coordinating inter-college performances (2018 to 2020).