TOMOSHREE DASH

Holcombe Department of Electrical and Computer Engineering
Clemson University, Clemson, SC 29634, USA
tdash@clemson.edu ◇ Google Scholar ◇ LinkedIn

Research Profile

Experimental nanophotonics researcher developing visible-wavelength metasurfaces and porous silicon photonic sensors for structural-color sensing, and image-based optical detection. Experienced in cleanroom fabrication, optical characterization, microfluidics, colorimetry, and image-based sensor analytics.

Education

Ph.D., Electrical and Computer Engineering — **Jan 2024 – Present**
Clemson University, Clemson, SC, USA
Dissertation: TBD
Advisor: Dr. Judson D. Ryckman

M.S., Electrical and Computer Engineering — **Dec 2025**
Clemson University, Clemson, SC, USA
Thesis: *Complementary Color Laser Illumination for Perceptual Contrast Enhancement in Structurally Colored Samples*

B.Sc., Electrical and Electronic Engineering — **Feb 2023**
University of Dhaka, Dhaka, Bangladesh

Research Experience

Graduate Research Assistant — **Jan 2024 – Present**
Nanophotonics Laboratory
DEIC, 81 Technology Drive, Anderson, SC 29625, USA

- Develop visible-wavelength nanophotonic sensing platforms based on porous silicon metasurfaces, structural color, and image-based optical detection; design and execute calibrated vapor, microfluidic, and biomolecular sensing systems with quantitative image/video analysis.

Visiting Researcher / User — **Aug 2025 – Present**
Center for Nanophase Materials Sciences (CNMS), Oak Ridge National Laboratory,
1 Bethel Valley Road, Oak Ridge, TN 37830, USA

- **Project:** Fabrication of Mesoporous Metasurfaces Operating at Visible Wavelengths.
- Conduct nanofabrication and optical characterization of mesoporous silicon metasurfaces through a CNMS user proposal.

Journal Articles

[J3] **T. Dash***, S. Gafsi*, E. M. Dos Santos, I. Kravchenko, and J. D. Ryckman. Responsive Visible-Wavelength Metasurfaces from Porous Silicon Based on Fano Guided-Mode Resonance. **Adv. Optical Mater.** 14, no. 12 (2026): e02295. **(Featured on back cover)**. *Equal contribution

[J2] **T. Dash**, E. M. D. Santos, T. H. Talukdar, and J. D. Ryckman. C2LI: Enhancing Structural Color Sensing and Imaging via Complementary Color Laser Illumination. **Adv. Optical Mater.** 13, no. 26 (2025): e00966. **(Featured on back cover)**

[J1] T. Jahan, **T. Dash**, S. E. Arman, R. Inum, S. Islam, L. Jamal, A. A. Yanik, and A. Habib. Deep learning-driven forward and inverse design of nanophotonic nanohole arrays: streamlining design for tailored optical functionalities and enhancing accessibility. **Nanoscale.** 16, no. 35 (2024): 16641–16651.

Manuscript Under Review

[**R1**] **T. Dash**, M. Morshed, I. Kravchenko, G. Koley, and J. D. Ryckman. Spectrometer-Free Quantitative Vapor Sensing and Classification using Spatiotemporal Imaging of Porous Silicon Metasurfaces.

Conference Proceedings & Presentations

[**C3**] **T. Dash**, M. Morshed, I. Kravchenko, G. Koley, and J. D. Ryckman. Imaging Porous Silicon Metasurfaces for Real-Time Spectrometer-Free VOC Sensing. **CLEO**, 2026.

[**C2**] **T. Dash**, M. Morshed, I. Kravchenko, G. Koley, and J. D. Ryckman. Real-time Spectrometer-Free VOC Sensing via Porous Silicon Metasurface Imaging. **Porous Semiconductors Science and Technology Conference**, 2026.

[**C1**] **T. Dash**, E. M. D. Santos, T. H. Talukdar, and J. D. Ryckman. Red-cyan complementary color laser illumination (C2LI) for perceptually enhanced sensing and imaging of structurally colored samples. In **Unconventional Imaging, Sensing, and Adaptive Optics 2025** SPIE, 2025.

Poster Presentations

2026 19th Annual MRS and Optica Poster Competition, Clemson, SC, USA
Spatiotemporal Imaging of Porous Silicon Metasurfaces for Spectrometer-Free Vapor Sensing and Classification.

2025 18th Annual MRS and Optica Poster Competition, Clemson, SC, USA
Complementary Color Laser Illumination (C2LI) for Perceptually Enhanced Structurally Colored Sensing and Imaging.

Selected Research Projects

1. **Enhanced Structural Color Sensing and Imaging via Complementary Color Laser Illumination**

   Developed Complementary Color Laser Illumination (C2LI), a non-digital color contrast-enhancement technique that exploits the psychophysical nonlinearity of human color perception to amplify subtle colorimetric changes in structurally colored samples.

   - Demonstrated enhanced color contrast in microfluidic refractometric sensing, vapor sensing, phase-contrast-enhanced microscopy, and semiconductor inspection.
   - Established C2LI as a simple illumination-based method for improving perception of small sample-property changes without computational post-processing.
   - Resulted in a first-author Advanced Optical Materials article featured as a back-cover publication.
   - *Sponsors:* NSF and AFOSR

2. **Responsive Porous Silicon Metasurfaces Operating at Visible Wavelength**

   Co-led the development and experimental validation of mesoporous silicon metasurfaces as a visible-wavelength platform for structural-color sensing and real-time image-based detection.

   - Led sensing experiments on porous silicon metasurfaces with visible-wavelength Fano resonances.
   - Developed the imaging setup and quantitative image-analysis workflows to characterize tunable resonances, structural coloration, and spatiotemporal color responses.
   - Demonstrated real-time refractive-index sensing using chirped differential metasurfaces integrated with a microfluidic flow cell.
   - *Collaborators:* Oak Ridge National Laboratory
   - *Sponsors:* NSF, AFOSR, and ORNL

3. **Spectrometer-Free Quantitative Volatile Organic Compound Sensing via Porous Silicon Metasurface Platform**

Developed a spectrometer-free, quantitative, calibrated vapor-sensing platform using spatiotemporal imaging of chirped differential porous silicon metasurfaces.

- Designed and executed vapor-sensing experiments and built quantitative image-analysis workflows for calibrated VOC detection.
- Achieved LODs of 1.65 ppm for methanol and 9.1 ppm for ethanol across a broad ∼1–2000 ppm dynamic range.
- Demonstrated >100× spectral sensitivity enhancement over non-porous guided-mode resonance sensors.
- Classified VOCs using machine-learning analysis of kinetic molecular fingerprints within the porous silicon matrix.
- *Collaborators:* Nanoscale Electronics and Sensor Laboratory, ECE, Clemson University; Oak Ridge National Laboratory
- *Sponsors:* NSF and ORNL

Technical Skills

Device Fabrication	Cleanroom micro/nanofabrication, e-beam lithography, photolithography, dry etching, chemical wet etching, porous silicon fabrication, nanoimprinting
Optical Characterization	Optical microscopy, spectroscopy, colorimetry, structural color imaging, photonic sensor characterization
Design & Simulation	Photonic integrated circuit design, KLayout, Tidy3D, GMR metasurface design
Experimental Systems	Microfluidic sensing, vapor sensing, optical imaging setup, laser imaging, image/video acquisition
Data Analysis	MATLAB, JMP, quantitative image analysis, video processing, data visualization, sensor response analysis

Awards & Achievements

2026 Article featured on the back cover of *Advanced Optical Materials*.

2025 Article featured on the back cover of *Advanced Optical Materials*.

2025 SPIE Student Travel Grant
SPIE Optics and Photonics 2025, San Diego, CA, USA

Professional Activities, Leadership & Service

Peer Reviews	*Small Structures* (Assisted PI as a reviewer); *Advanced Science* (Assisted PI as a reviewer)
Student Membership	SPIE