Ziyad Thekkayil

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Research Interests

Understanding the structure and dynamics at oxide/water interfaces using steady state and transient nonlinear vibrational spectroscopy.

Education

Ph.D., Temple University, Philadelphia, PA, USA — Fall 2022 – Present
Advisor: Prof. Eric Borguet

BSMS, Indian Institute of Science Education and Research, Pune — 2018 – 2023
Advisor: Dr. Pankaj Mandal

Research Experience

I. Graduate Research Assistant at Temple University (2022-)

Advisor: Prof. Eric Borguet

Understanding surface chemistry at surfaces/interfaces using vibrational spectroscopy. Experienced in fs-laser operation and troubleshooting, steady state and time-resolved sum frequency generation spectroscopy, developed a code for transient vSFG spectra analysis. Currently leading the nonlinear optics team within the Borguet group. Mentored 1 graduate student, 3 masters students and 4 undergraduate students.

Projects:

1. "Impact of nuclear quantum effects on interfacial hydrogen bonding networks"; Somaiyeh Dadashi, **Ziyad Thekkayil**, Aashish Tuladhar, Olivia Martin, Rick Remsing, Eric Borguet

2. “Proton exchange at alumina/water interfaces”; **Ziyad Thekkayil**, Xianglong Du, Mark DelloStritto, Fujie Tang, Jun Cheng, and Eric Borguet
3. “Impact of functional groups on water ordering at alumina/water interfaces”; **Ziyad Thekkayil**, Mark DelloStritto, and Eric Borguet
4. “NIR-vSHG: A new nonlinear vibrational spectroscopy of interfaces”; Somaiyeh Dadashi, **Ziyad Thekkayil**, Hao Li, Bijoya Mandal, Eric Borguet
5. “Understanding interaction of solvents and ions adsorbed inside MOFs using vibrational spectroscopy”; Souvik Pramanick, Robert Castillo, Maxime Zitouni, David Pinel, **Ziyad Thekkayil**, Hao Li, and Eric Borguet.
6. “Probing confined water in layered materials using vibrational spectroscopy”; **Ziyad Thekkayil**, Mohsen Rostami Sakha, Souvik Pramanick, Michael J. Zdilla, and Eric Borguet.
7. “Probing spin polarized topological bands in antiferromagnetic Weyl semimetal Mn_3Sn using SHG”; **Ziyad Thekkayil**, Somaiyeh Dadashi, Prajwal Laxmeesha, Benjamin Roe, Daniel Strongin, Steven May, and Eric Borguet
8. “Development of high resolution nonlinear optical microscopy and time-resolved spectroscopy system for interfacial studies”; Somaiyeh Dadashi, **Ziyad Thekkayil**, Eric Borguet

II. Undergraduate research student at IISER Pune (2019-2022)

Advisor: Dr. Pankaj Mandal Graduate Student Mentor: Ms. Shabnum Maqbool

- Studied nonlinear optical properties and charge carrier dynamics in lead halide perovskites.
- Developed a Z-scan spectrometer for nonlinear optical studies of perovskite thin films.
- Mentored a 1st year PhD student during the 4th year of my BSMS, training in the use and alignment of ultrafast lasers, and nonlinear optics.
- Developed experience in fs-laser systems, optical alignment, ultrafast laser detection, generation of THz pulses via laser-induced air plasma, THz time-domain spectroscopy, and data analysis of optical pump – THz probe spectroscopy and optically-heterodyne-detected optical Kerr effect spectroscopy.

Publications

1. Somaiyeh Dadashi, **Ziyad Thekkayil**, Aashish Tuladhar, Olivia Martin, Rick Remsing, and Eric Borguet. "Impact of nuclear quantum effects on interfacial hydrogen bonding networks" (*in preparation*)
2. Shabnum Maqbool, Garvit Bansal, Gurivi Reddy Yettapu, **Ziyad Thekkayil**, and Pankaj Mandal. "Carrier localization charge carrier dynamics in Formamidinium lead bromide nanocrystals using time-resolved Terahertz spectroscopy" (*in preparation*)
3. Somaiyeh Dadashi, **Ziyad Thekkayil**, Hao Li, Bijoya Mandal, Eric Borguet. "Near Infrared Vibrational Second Harmonic Generation: a New Nonlinear Interfacial Vibrational Spectroscopy" *Faraday Discussions*, **2026**. https://doi.org/10.1039/D5FD00124B
4. **Ziyad Thekkayil**, Shabnum Maqbool, Riteeka Tanwar, and Pankaj Mandal. "Broadband Tunability of Third Harmonic Upconversion in Pyridinium Lead Halides" *ACS Photonics*, **2024**, 11, 196-203. https://doi.org/10.1021/acsphotonics.3c01279
5. Shabnum Maqbool, **Ziyad Thekkayil**, and Pankaj Mandal. "1D Diisopropylammonium Lead Iodide Perovskite Shows Exceptional Optical Stability and Third-Order Nonlinearity" *Advanced Optical Materials*, **2023**, 2202942. https://doi.org/10.1002/adom.202202942
6. Shabnum Maqbool, Tariq Sheikh, **Ziyad Thekkayil**, Swati Deswal, Ramamoorthy Boomishankar, Angshuman Nag, and Pankaj Mandal. "Third Harmonic Upconversion and Self-Trapped Excitonic Emission in 1D Pyridinium Lead Iodide" *The Journal of Physical Chemistry C*, **2021,** *125*, 22674-83. https://doi.org/10.1021/acs.jpcc.1c07639

Presentations

1. "Nonlinear Optical Spectroscopic Study of Topological Weyl Semimetals", **Ziyad Thekkayil**, Pankaj Mandal, and Eric Borguet, **May 2023**, IISER MS Thesis Defense Presentation (via Zoom), IISER Pune, India
2. "Development of ultrafast broadband tunable repetition rate mid-IR sources" **Ziyad Thekkayil**, Somaiyeh Dadashi, and Eric Borguet, **October 2023**, YCC 2023 (Poster Presentation), Philadelphia, PA
3. "2nd Second Harmonic Generation Spectroscopic Study of Weyl Semimetal Mn_3Sn with Broken Time-Reversal Symmetry" **Ziyad Thekkayil**, Somaiyeh Dadashi, Prajwal Laxmeesha,

Steven May, and Eric Borguet, **November 2023**, MRS Fall 2023 Meeting (Poster Presentation), Boston, MA

4. "IMPACT OF NUCLEAR QUANTUM EFFECTS ON THE VIBRATIONAL RELAXATION OF INTERFACIAL WATER", **Ziyad Thekkayil**, Somaiyeh Dadashi, Aashish Tuladhar, and Eric Borguet, **June 2025**, ISMS 2025 (Oral Presentation), University of Illinois at Urbana-Champaign, Illinois
5. "Dehydroxylation and Deuteration of Buried Free-OH in Muscovite Mica" **Ziyad Thekkayil**, Somaiyeh Dadashi, Sharan Dhar, and Eric Borguet, **September 2025**, YCC 2025 (Poster Presentation), Philadelphia, PA

Conference & Seminar Duties

- Coordinator, Student-Hosted Seminar Series, Department of Chemistry, Temple University, 2025-27
- Symposium assistant, MRS Fall 2023 Meet (Nov 26 – Dec 01, 2023)

Honors and Achievements

- Selected for IISER Pune – Temple University DMDD (Dual Masters Doctoral Degree) program. Admitted for PhD program at Temple University in the pre-final year of the BSMS program at IISER Pune (2022).
- Awarded Government of India Dept. of Science & Technology INSPIRE-SHE (Innovation in Science Pursuit for Inspired Research – Scholarship for Higher Education) (2018 – 2023).

Teaching Experience

- Teaching Assistant, Temple University Chemistry, General Chemistry Laboratory I, Spring 2026, Course Faculty: Dr. John B. Michael
- Teaching Assistant, Temple University Chemistry, General Chemistry Laboratory II, Fall 2024, Course Faculty: Dr. John B. Michael
- Teaching Assistant, Temple University Chemistry, General Chemistry Laboratory I, Spring 2023, Course Faculty: Dr. John B. Michael
- Teaching Assistant, Temple University Chemistry, General Chemistry Laboratory I, Fall 2022, Course Faculty: Dr. John B. Michael

Instrument & Technical Skills

• Operation, maintenance, and minor troubleshooting of ultrafast lasers: 1. Millenia – Tsunami – Spitfire XP (Regenerative Amplifier system, Spectra-Physics) 2. Libra (Coherent) 3. Monaco (Coherent) 4. TOPAS-C and TOPAS-Prime (OPA, Light Conversion) 5. Opera-HP (OPA, Coherent)	• THz pulse generation via laser-induced air plasma • Lock-in amplifier • Oscilloscope • Function Generator • Raman microscope • FTIR spectrometer • UV-Vis-NIR spectrometer • Powder X-Ray Diffractometer • Synthesis of hybrid lead halide perovskites

Software Skills

➢ Python – data analysis and instrument control ➢ LabVIEW – instrument control ➢ Gaussian – Electronic structure calculations ➢ MATLAB – data analysis ➢ IgorPro	➢ OriginPro ➢ ChemDraw ➢ EndNote ➢ SciDAVis ➢ MS Office

Extra-Curricular Activities

- ➢ Founding member of Board of Governors, ElevatED, a holistic STEM education and upliftment project based in Kerala, India (2024 –)
- ➢ Mentor, PhD Compass, an initiative to guide students for PhD applications. Successfully mentored 9 students who got admitted to PhD programs in USA and Europe), (2023 –)
- ➢ IISER Pune Sports Club Coordinator (2021-22)
- ➢ Elected Member of the first Student Council of IISER Pune, (2020-21)
- ➢ Organizer, IISER Pune Kho-Kho League, (2020)
- ➢ Bronze Medal, Kho-Kh, Inter IISER Sports Meet, (2019)