

Ziyad Thekkayil

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Research Interests

Understanding the structure and dynamics at interfaces using ultrafast steady state and transient nonlinear 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: Prof. Pankaj Mandal

Research Experience

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

Advisor: Prof. Eric Borguet

Understanding surface chemistry at surfaces/interfaces using nonlinear 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 PhD student, 3 masters students and 5 undergraduate students.

Projects:

1. “Impact of nuclear quantum effects on interfacial hydrogen bonding networks”; Somaiyeh Dadashi, **Ziyad Thekkayil**, Aashish Tuladhar, Olivia Martin, Rick Remsing, and Eric Borguet
2. “Proton exchange at alumina/water interfaces”; **Ziyad Thekkayil**, Xianglong Du, Mark DelloStritto, Fujie Tang, Jun Cheng, and Eric Borguet
3. “Facet dependent 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, and 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”; Mohsen Rostami Sakha, **Ziyad Thekkayil**, Souvik Pramanick, Eric Borguet, and Michael J. Zdilla.
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**, and 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 the Vibrational Relaxation of Interfacial Water” (*in preparation*, [#] equal contribution)
2. **Ziyad Thekkayil**, Xianglong Du, Mark DelloStritto, Fujie Tang, Jun Cheng, and Eric Borguet. “Proton Exchange at Alumina/Water Interfaces” (*in preparation*)
3. **Ziyad Thekkayil**, and Eric Borguet. “Vibrational Spectroscopy of Particle and Droplet Interfaces” (review article, *in preparation*)
4. Souvik Pramanick, Robert Castillo, David Pinel, Maxime Zitouni, **Ziyad Thekkayil**, Anastasia Ilgen, Dorina Sava Gallis, and Eric Borguet “Detecting atomic and molecular ions inside UiO-66 Metal-Organic Frameworks using vibrational spectroscopy” (*in preparation*)
5. 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*)

6. Somaiyeh Dadashi, **Ziyad Thekkayil**, and Eric Borguet. “Near Infrared Vibrational Second Harmonic Generation: a New Nonlinear Interfacial Vibrational Spectroscopy” *Faraday Discussions*, **2026**. <https://doi.org/10.1039/D5FD00124B>
7. **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>
8. 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>
9. 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, Maharashtra, 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, Pennsylvania, USA
3. “2nd Second Harmonic Generation Spectroscopic Study of Weyl Semimetal Mn₃Sn 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, Massachusetts, USA
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, USA
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, Pennsylvania, USA
6. “Proton Exchange at Alumina/Water Interfaces” **Ziyad Thekkayil**, Xianglong Du, Mark DelloStritto, Fujie Tang, Jun Cheng, and Eric Borguet, **August 2026**, Vibrational Spectroscopy GRS (Poster Presentation), South New Hampshire University, Manchester, New Hampshire, USA

7. “Impact of Nuclear Quantum Effects on the Vibrational Relaxation of Interfacial Water” **Ziyad Thekkayil**, Somaiyeh Dadashi, Olivia A. M. Martin, Richard C. Remsing, and Eric Borguet, **August 2026**, Vibrational Spectroscopy GRC (Poster Presentation), South New Hampshire University, Manchester, New Hampshire, USA

Conference & Seminar Duties

- Coordinator, Student-Hosted Seminar Committee, Department of Chemistry, Temple University, Jan 2025 – Dec 2026
- 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 • Scanning Electron Microscope – EDS
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Software Skills

➤ Python – data analysis and instrument control ➤ LabVIEW – instrument control ➤ Gaussian – Electronic structure calculations ➤ MATLAB – data analysis ➤ SNLO	➤ Igor Pro ➤ Origin Pro ➤ ChemDraw ➤ SciDAVis ➤ EndNote ➤ MS Office
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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 11 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-Kho, Inter IISER Sports Meet, (2019)