

Aruna Kumarasiri, PhD

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Professional Summary

Experimental optical systems engineer with 6+ years in R&D: 4+ years in optical instrumentation and 2+ years in industrial R&D. Designs, aligns, calibrates, and automates **custom laser spectroscopy systems** using Python. Delivered a five-subsystem automation workflow that reduced experiment time by approximately **50%** and a calibration method that recovered data to **within 2%** of expected values.

Skills

Optical Systems: Custom picosecond-laser spectroscopy systems, optical alignment, polarization control, calibration
Automation & Data: Python (NumPy, Pandas, SciPy), unattended instrument control, spectral acquisition, data processing
Engineering Tools: COMSOL Multiphysics (Electrochemistry Module), SOLIDWORKS, Git/GitHub

Experience

University of Victoria

Graduate Research Assistant

Victoria, BC, Canada

Sep 2021 – Apr 2026

Optical System Development & Automation

- Reconfigured and realigned a custom picosecond-laser SFG spectroscopy system 🔗, expanding its capability from air–water interface measurements with fixed polarization configurations to **buried-interface characterization with continuous 0–180° polarization control** 🔗
- Developed a **Python-based instrument-control and data-analysis workflow** for a spectroscopy system, integrating five optical and data-acquisition subsystems to automate polarization control, spectral acquisition, data organization, signal processing, and peak fitting, reducing end-to-end experiment time by approximately 50% 🔄
- Customized and calibrated a Renishaw inVia confocal Raman microscope 🔗 for **polarization-resolved Raman spectroscopy** by integrating and aligning polarization optics in the excitation and detection paths, enabling quantitative material characterization 📄
- Developed a **Python-based FT-IR data-analysis workflow** to process native OPUS files from a Bruker VERTEX 70 FT-IR spectrometer 🔗 and perform quantitative spectral modelling and complex refractive-index retrieval for nonlinear-optical analysis 🔄📄

Optical Metrology, Calibration & Method Development

- Developed and validated a dual-null-angle SFG calibration method that cross-calibrated three polarization configurations and **recovered reference values within 2% of expected values** 📄🔗
- Designed and automated an azimuthal z-cut quartz calibration workflow using a **Python-controlled motorized rotation stage**, correcting polarization bias from beamsplitter branching ratios and changes in IR–visible beam overlap in a vibrational SFG spectroscopy system 📄🔗
- Built a **Python–LabVIEW knife-edge beam-profiling system** that synchronized a motorized translation stage with detector acquisition and applied sigmoid and Gaussian fitting to determine the FWHM widths of visible and tunable-IR beams from automated 20 μm step scans 🔄

Quantitative Spectroscopy & Optical Modeling

- Developed a minimum-assumption orientation-analysis framework for high-symmetry vibrational modes, extracting molecular-orientation parameters without imposing a predefined distribution and **avoiding errors of up to 10.4× and sign reversals** from conventional analyses (*manuscript accepted pending revision*)
- Co-developed and **experimentally validated a population-weighted Lorentz–Lorentz model** of the interfacial refractive index using molecular-dynamics depth profiles, bringing simulated nonlinear-susceptibility ratios into agreement with experimental SFG data 📄

Flintec Transducers Inc. 🔗

Research and Development Engineer

Sri Lanka

Mar 2020 – Aug 2021

- Reported to:* Manuja Wickramaratne, Research & Development Manager ✉
- Translated **laboratory-scale research into scalable manufacturing processes** for a new electronic sensor product line, spanning process development, validation, and industrial implementation 🔗
- Investigated process–performance relationships in Ni20Cr-based strain gauges using **microhardness testing, SEM/EDAX, and XRD** to improve reliability and manufacturing consistency 🔗🔗
- Modeled and optimized electroplating bath conditions using the Electrochemistry Module in COMSOL Multiphysics® 🔗 to develop a novel electroplating process that **improved solderability by 20%** 📄
- Designed an experimental setup to measure the contact angles of solder droplets, demonstrating **contact-angle reductions exceeding 50% and 60%** through chemical treatment and nickel electroplating, respectively 📄🔗

- Supervised by: Manuja Wickramaratne, Research & Development Manager
- Developed a **surface-treatment and electroplating protocol** for nichrome alloys using ZnCl_2/HCl treatment followed by a two-step nickel electroplating process to improve solderability
- Optimized **electroplating pH, nickel-layer thickness, and current density** for compatibility with lead-free SN100C solder, improving adhesion and enabling reliable industrial-scale soldering
- Developed and standardized **image-processing software in Visual Basic .NET 16.0** to measure solder-droplet contact angles using polynomial- and ellipse-fitting algorithms with 99% accuracy
- Designed an industry-ready **hardware-software system using Keysight BenchVue** for real-time data acquisition and determination of the resistance temperature coefficient (RTC) of strain gauges with ± 1 ppm precision

Selected Publications

R – Manuscript under review J – Journal C – Conference

- [R] Minimum-assumption sum-frequency orientation analysis for molecules with high-symmetry vibrational modes.
A. Kumarasiri, A. Yousefi, and D. K. Hore
Manuscript under review at The Journal of Chemical Physics.
- [J] Sum frequency dual null angle approach and its use in surface hyperpolarizability ratio measurements.
A. Kumarasiri, P. Yang, and D. K. Hore
The Journal of Chemical Physics, 163, 084715 (2025) **Editor's Pick**
- [J] Surface populations as a model for the distance dependence of the interfacial refractive index.
P. Yang, A. Kumarasiri, and D. K. Hore
The Journal of Chemical Physics, 161, 054703 (2024)
- [J] Second-Order Nonlinear Optics as an Orientation-Independent Probe of Molecular Environments at Interfaces.
A. Kumarasiri, P. Yang, and D. K. Hore
The Journal of Physical Chemistry Letters, 14, 4449–4453 (2023)
- [C] Effects of Current Density on the Solder Wettability of Nickel Electrodeposited Ni20Cr Alloy.
A. Kumarasiri, H. S. Herath, D. A. S. Amarasinghe, and D. Attygalle
2021 Moratuwa Engineering Research Conference (MERCon), 649–653
- [C] Lead Free Solder Compatibility Improvement on Nichrome Alloy Through Contact Angle Modification.
A. Kumarasiri, D. Attygalle, and D. A. S. Amarasinghe
2019 Moratuwa Engineering Research Conference (MERCon), 340–344 **Best Scientific Paper Award**

Education

University of Victoria

Victoria, BC, Canada

PhD in Chemistry with a focus on Physical Chemistry and Nonlinear Optical Spectroscopy

2021 – 2026

- **Advisor:** Dr. Dennis K. Hore
- **Thesis** : Second-Order Nonlinear Optics as an Orientation-Independent Probe of Molecular Environments at Interfaces
- **Research Focus:** Vibrational sum-frequency generation spectroscopy, nonlinear optics, molecular interfaces, polarization-resolved spectroscopy, molecular-orientation analysis, and optical instrumentation
- **Selected Coursework:** Quantum Chemistry and Spectroscopy, Advanced Molecular Spectroscopy, Materials Science

University of Moratuwa

Sri Lanka

B.Sc. in Engineering (Hons.) specialized in Materials Science and Engineering

2015 – 2020

- **Honors:** Dean's List | **Minor:** Electronic and Optical Device Engineering
- **Advisors:** Dr. D. A. S. Amarasinghe and Dr. D. Attygalle
- **Thesis** : Development of a Method to Measure Contact Angles of Sessile Droplets to Analyze and Enhance the Surface Wettability of Nichrome

Professional Activities

University of Victoria Optical Society (UVOS)

Victoria, BC, Canada

Treasurer

2024 – Present

- Manage chapter finances for the joint Optica and SPIE student chapters; **designed the society's website and continue to maintain it**; and have delivered technical talks, including a chalk talk on nonlinear-optical analysis of molecular interfaces

Canadian Chemistry Conference and Exhibition (CSC 2023)

Vancouver, BC, Canada

Education Volunteer

Jun 2023

- Supported education-focused activities, attendee engagement sessions, and on-site delivery during the five-day national chemistry conference

Project Portfolio: Detailed summaries of selected research and engineering projects are available on my website