TRENT UNIVERSITY

BOB AND SIBYL STAIRS CHEMISTRY SEMINARS

Dr. Jun-Ray Macairan

Assistant Professor, Department of Chemistry, Trent University

Wednesday, September 17th, 2025
11:00 a.m. to 11:50 a.m. in ENW 115

Advancing Sustainable Approaches for Contaminant Detection and Remediation

ABSTRACT

A major focus of the MAC Lab at Trent University is the use of carbon dots as versatile nanomaterials for sensing in biological and environmental systems. By tuning their surface chemistry and optical properties, we are developing carbon dots as fluorescent probes for applications such as intracellular pH monitoring, temperature sensing, and the detection of priority contaminants including heavy metals and organic pollutants. These capabilities highlight the broad potential of carbon dots to serve as robust tools at the interface of biology and the environment.

In parallel, we are advancing analytical methodologies that provide new0 perspectives on pollutant fate and behavior. One example is label-free optical photothermal infrared (O-PTIR) microspectroscopy, which enables direct visualization of micro- and nanoplastics within biological tissues without the need for labeling. Such approaches complement our materials work by offering a clearer picture of how contaminants interact with complex systems.

Together, these efforts reflect the MAC Lab's vision: leveraging sustainable nanomaterials for sensitive detection while developing novel methodologies to better monitor and understand pollutants in biological and environmental contexts

BIOGRAPHY

Jun-Ray Macairan

Dr. Jun-Ray Macairan is an Assistant Professor of Chemistry at Trent University, where he leads the Management and Assessment of Contaminants (MAC) Lab. He completed his BSc in Chemistry at Concordia University in 2016 and stayed on for his PhD, graduating in 2021 under the supervision of Prof. Rafik Naccache. His doctoral work explored the fluorescence mechanisms of carbon dots and their use in sensing, and he was recognized with Concordia's top academic honors, including Valedictorian, the Governor General's Gold Medal, and the Best Thesis Award. From 2021 to 2024, Jun-Ray was an NSERC Postdoctoral Fellow at McGill University in the Biocolloids and Surfaces Lab with Prof. Nathalie Tufenkji. There, he worked on new ways of studying micro- and nanoplastics in aquatic systems, using techniques such as lightsheet microscopy with tissue clearing and optical photothermal infrared (O-PTIR) microspectroscopy. At Trent, he is building a research program that combines his interests in nanomaterials and spectroscopy. The MAC Lab is working on carbon dots for pollutant detection, cellulose fibers for sustainable remediation, and new analytical approaches for monitoring pollutants in complex environments. Altogether, his doctoral and postdoctoral research has resulted in more than 20 peer-reviewed publications, including contributions in Trends in Analytical Chemistry (TrAC), Environmental Science: Nano, and Environmental Science & Technology