ANALYTICAL SEMINAR

Jia Chen

Graduate Student
Cooks Group
Purdue University

"Toward a Chemical Microscope: Spatially Resolved NMR with Diamond Quantum Sensors"

Nuclear magnetic resonance (NMR) spectroscopy is one of the most widely used analytical tools in organic chemistry. Conventional inductive NMR, however, typically reports an ensemble-averaged signal from the detected sample volume and does not retain any information about the spatial distribution of chemicals. Optical widefield NMR microscopy offers a route to address this challenge by using nitrogen-vacancy (NV) centers in diamond as quantum sensors that convert NMR magnetic signals from precessing nuclear spins into optically detectable fluorescence signals. When this fluorescence is recorded with a high-speed camera, NMR signals can be measured on a pixel-by-pixel basis, creating a path toward a "chemical microscope" capable of spatially tracing chemical composition and reaction progress. It also provides direct compatibility with optical microscopy, microfluidic devices, and small-volume chemical samples. This presentation will introduce the operating principles of optical widefield NMR microscopy and discuss its potential as an emerging platform for microscale chemical analysis. As it currently stands, the technique is strongly limited by spectral resolution and sensitivity, but future iterations have promising potential: the combination of NMR's chemical specificity with spatial readout may ultimately enable non-destructive analysis of composition, transport, and reaction progress in a variety of microscopic systems.

ANALYTICAL SEMINAR

Teresa Lee

Graduate Student
McLuckey Group
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"Challenges and Applications of Neutron Reflectometry"

Neutron reflectometry is a technique that uses neutrons to determine the composition and thicknesses of various interfaces. It relies on measuring the reflectivity of neutrons elastically scattered off a surface or interface; this is a non-destructive technique due to the weak interaction between incident neutrons and sample nuclei. The interaction between neutrons and sample interface is also dependent on the atomic number and the isotopes (1H vs. 2D) present in the sample, which can be used to improve contrast for biological samples. This presentation discusses the fundamentals of neutron reflectometry and relevant challenges in biological applications.