

ANALYTICAL SEMINAR

Jeremy Lawrence



Graduate Student
Dick Group
Purdue University

“So You Want to Go Sub-Angstrom? Accessing High-Resolution Analysis via Electron Ptychography”

Transmission electron microscopy (TEM) is a powerful technique for achieving high spatial resolution, providing detailed information on morphology and atomic structure. However, TEM suffers from resolution losses due to aberration errors and other systematic artifacts. While recent approaches to instrumentation have concentrated on aberration correction, electron ptychography has emerged as a powerful tool to substantially enhance spatial resolution and deliver increased atomic information. In electron ptychography, 4D scanning transmission electron microscopy (4D STEM) is combined with an electron microscope pixel array detector (EMPAD) for high throughput generation and detection of diffracted electrons with overlapping diffraction patterns. Using iterative algorithms, the electron phase information encoded in detected electrons can be reconstructed, rendering a map of sample electron density. In the past decade, electron ptychography has dramatically expanded the capabilities of TEM, achieving spatial resolutions up to 0.20 Å (20 pm). Jointly, it has enabled imaging of thick (50-100 nm) samples under high resolution conditions, representing a significant advance in measurement science for imaging at the atomic scale.

ANALYTICAL SEMINAR

Renny Pham

Graduate Student
Dick Group
Purdue University



"Paper-Based SERS Platforms for Rapid Food Contaminant Detection"

To ensure food safety and protect consumer health, testing and detecting contaminants is necessary and important today. To test this, researchers often use high precision techniques such as chromatography or mass spectrometry, but it requires expensive, complex equipment and is conducted professionally in the laboratory. Surface Enhanced Raman Spectroscopy (SERS) offers a potential solution by combining the specificity of molecular fingerprinting with superior signal amplification through plasmonic nanostructures. Paper-based SERS platforms fabricated from silver nano inks enable the easy, low-cost detection of analytes such as tetracycline in milk without the need for a tracer with minimal sample preparation. The controlled assembly of biopolymer layers for growing gold nanoparticles in situ further enhances the density of plasmonic hotspots, achieving high amplification factors and improved signal reproducibility. These designed platforms demonstrate low detection limits and successful performance in real world food matrices. Overall, plasmonic paper-based SERS systems represent practical, portable, and scalable analytical platforms capable of connecting to laboratory spectroscopy and monitoring contamination in situ.

Govindi Dewage



Graduate Student
J. Laskin Group
Purdue University

“Near-Infrared Chemiluminescent Probes for Superoxide Detection in Biological Systems”

Superoxide ($O_2^{\bullet-}$) is a key reactive oxygen species involved in oxidative stress and neurodegenerative diseases, yet its short lifetime and low abundance make it difficult to detect in biological systems. Chemiluminescent probes provide an excitation-free strategy for sensitive superoxide detection, but conventional systems are limited by poor tissue penetration and probe instability. Recent advances in molecular design have enabled near-infrared emission and improved probe performance in vivo. Modification of classical chemiluminescent scaffolds has led to probes with enhanced optical properties, reduced auto-oxidation, and improved biological compatibility, including the ability to cross the blood–brain barrier. These developments illustrate how rational structural design can address both photophysical and biological constraints in superoxide imaging.