ANALYTICAL SEMINAR

Integrated High-Mobility Emissive Organic Semiconductors for Advanced Optoelectronics and UV-Sensitive Devices

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High mobility emissive organic semiconductors (HMEOSCs) represents a group of materials that combine high charge carrier mobility and strong emission characteristics—two features traditionally seen as mutually exclusive. These materials address critical performance bottlenecks in current organic optoelectronic devices and enables high-density integrated circuits for smart displays and electrically pumped organic lasers (EPOLs). HMEOSCs are particularly significant for improving efficiency and stability in organic photovoltaic cells (OPVs), organic light-emitting diodes (OLEDs), and organic light-emitting transistors (OLETs). Recently, the key advancements include the synergistic optimization of charge transport properties, solid-state emission, and energy levels to achieve enhanced performance metrics, such as power conversion efficiencies exceeding 20% in OPVs and external quantum efficiencies up to 40% in OLEDs. Specifically, organic photodetectors (OPDs) with UV sensitivity is a promising application of HMEOSCs. Synthesizing novel semiconductors such as 1,6-distriphenylamineethynylpyrene (1,6-DTEP) and 2,7-distriphenylamineethynylpyrene (2,7-DTEP), high charge carrier mobility, long exciton diffusion lengths, and unique UV sensitivity was achieved. Despite ongoing challenges such as balancing molecular structure and packing requirements, HMEOSCs open the door to transformative applications in multifunctional optoelectronic devices and organic UV photodetectors, positioning them as key materials for the next generation of organic electronics.

Tuesday, February 4, 2025 | **3:30 pm** | **WTHR 320**

PURDUE UNIVERSITY | James Tarpo Jr. and Margaret Tarpo Department of Chemistry

ANALYTICAL SEMINAR

Single Laser Advancements for Optical Tweezer Manipulation

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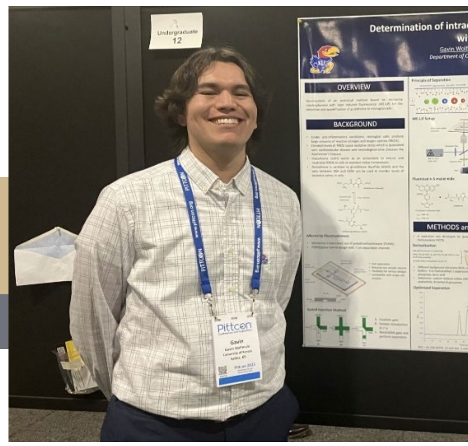

Optical tweezers are trapping devices that exploit the small-scale forces exerted by lasers enabling them to trap nano-objects or cells allowing for applications like nanofabrication and bioanalysis. These tweezers allow for the probing of interactions on this microscopic scale with reduced chances of damage that arise from the use of physical tweezers. In addition, they allow for transport in liquid environments which isolates cells of interest and enables direct analysis. Optical tweezers struggle with interactions at a solid-solid interface as the forces exerted by the laser cannot overcome the adhesive interactions experienced by the trapped object. Another restriction on trapping manipulation is the treatment of the object as a point particle rather than a rigid body. This reduces the amount of rotational manipulation that the tweezers can exert on the object of interest. Recent advancements have created a method that utilizes a single laser to overcome the adhesive forces experienced while trapping, and a method to exploit rigid body mechanics to rotate objects helping to address these two limitations.

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ANALYTICAL SEMINAR

Recent Advancements in Miniature Ultrasensitive Spin-Exchange Relaxation-Free (SERF) Atomic Magnetometers

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Spin-exchange relaxation-free (SERF) magnetometers have demonstrated the highest magnetic field sensitivity of any magnetometer, even surpassing the sensitivity of superconducting quantum interference devices (SQUIDs) and have diverse applications in the detection of dark matter, geophysical surveying, as well as biomedical imaging. SERF magnetometers function by manipulating the spin states of alkali metal atoms within a vapor cell, but the bulky optical components needed for operation are the main barrier in miniaturizing these instruments. There have been multiple attempts to modify SERF's components so that the system is more compatible to miniaturization, such as the implementation of a microelectromechanical (MEMS) atomic vapor cell as well as utilizing a single polarization-transformation metasurface. This seminar will focus on the strengths and weaknesses of the above strategies for miniaturization.

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