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CBE Seminar Series – Spring 2022

Dr. Mark S. Chen

Professor
Department of Chemistry
Lehigh University

Seminar: Wednesday, January 19, 2022
9:30 a.m. (ONLINE)

WebEx link: https://rensselaer.webex.com/rensselaer/onstage/g.php?MTID=e74f7d2e541e684bca523729f4cb17fbd
Password: CBESeminar

"Open-Shell Molecules: A Radical Design for Organic Optoelectronic Materials"

Abstract:

Open-shell molecules possess unpaired electron density (radical character), which makes them intriguing candidate materials for many optoelectronic applications. Air-stable structures have been reported, but most require lengthy synthetic sequences with limited generality. Our lab has developed a concise synthetic strategy to rapidly access a variety of bisphenalenyls from commercial starting materials. We used this method to synthesize a neutral biradicaloid, Ph2-s-IDPL, and several novel heteroatom-substituted, π-radical cations. One such molecule is O-substituted (Ph2-PCPL)(OTf), which displays electrostatically-enhanced, intermolecular covalent-bonding interactions that impart remarkable charge transport properties. Specifically, we have discovered soluble derivatives that, when mixed with polystyrenesulfonate (PSS), enable the formation of water-processable, n-type conductive organic films that demonstrate high optical transparency (>94% transmission), electrical conductivity (σrt < 117 S/cm), and electron mobility (μe < 322 cm2 V-1 s-1). In these composites, PSS not only serves as a counterion, but also promotes n-doping and solution-phase aggregation, which leads to molecular ordering in solid-state. We have also discovered a N-substituted, red emissive, π-radical cation [(Ph2-PQPL)(OTf)] that is structurally distinct from all other reports of luminescent radicals, and achieves rare antiambipolar charge transport in field-effect transistors. N-substituted bisphenalenyls also display self-sensitized and reversible reactivity with dioxygen, which shows potential for applications for oxygen sensors and antimicrobial coatings.

Biography:

Mark Chen is an assistant professor in the Department of Chemistry at Lehigh University. He received his B.A. and Ph.D. in Chemistry from Harvard University with M.-Christina White developing catalytic C-H bond oxidation methodologies. As a Dreyfus postdoctoral fellow in the lab of Jean Fréchet at U. C. Berkeley, he led a team developing polymeric and molecular materials for organic electronic devices. Since coming to Lehigh University, the Chen Lab has investigated the synthesis of open-shell organic molecules and their application to optoelectronic materials and devices. Mark is the recipient of several awards, including a Kaufman Foundation New Investigator Award (2015) and NSF CAREER Award (2021).

Due to COVID-19, no refreshments will be available for this seminar.

For more information, please contact Lisa Martin (swishl@rpi.edu) or Vidhya Chakrapani (chakrv@rpi.edu)