WPI CHEMISTRY & BIOCHEMISTRY

Wednesday, November 5, 2025, 12:00 PM
Gateway Park 1002

James Reuther
Associate Professor, UMASS -Lowell

"Advanced Materials Research in the Reuther Group: From Chiral Nanomaterials to Polyurethane Vitrimers "

Research in the Reuther group lies on the interface of polymer chemistry, supramolecular chemistry, materials science and nanoscience with projects ranging from basic science to applied materials research. This seminar will touch on two, unrelated projects that currently dominate the research in the lab: 1) synthesis and application of polyurethane vitrimers for footwear and 2) synthesis of chiral nanomaterials with unique light-matter interactions. Polyurethane (PU) thermosets are essential in numerous commercial applications but present significant environmental challenges due to their limited recyclability and biodegradability. In the first project, we detail the use of drop-in diols that can be integrated into commercial PU formulations without any changes to industrial processing protocols to impart catalyst-free melt-processability and chemically-triggered thermoset deconstruction for mechanical and chemical recycling of PU, respectively. A series of three dynamic conjugate acceptor (DCA) diols were synthesized and introduced into PU resin formulations providing tunable properties based on dynamic exchange kinetics and thermodynamics.

Controlling chirality at the nanoscale can provide access to unique, emerging properties such as chiral plasmonics, photonics, spin-photon and spin-orbit coupling, negative indices of refraction, and circularly-polarized luminescence (CPL).The second project we will discuss the recent combinations of PI-CDSA with chiral, helical rod-coil poly(aryl isocyanide) triblock copolymers to afford polymer nanoparticles with engineered sizes, dimensionality (transitioning from 1D to 2D to 3D nanostructures), nanostructured chirality, and intense optical activity. Recent work in our group has focused on incorporation of functional isocyanide monomers containing modular pentafluorophenylester (PFP) and pyridyl side-chains enabling the direct size tuning of 2D hexagonal platelets via self-limiting CDSA controlled by functional monomer incorporation. Reduction of gold(I) salts bound to chiral soft-templates via pyridyl side chains allows for uniform gold nanoseed formation. The high concentration and local confinement of gold seeds on chiral nanosheets provides a platform for enhanced symmetry breaking during laser-assisted gold overgrowth yielding chiral plasmonic nanocomposites.

Host: Ron Grimm