Sivula Laboratories

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General areas

Synthetic Chemistry, Chemical Engineering, Nanotechnology

Research themes

The main objective of this group’s research is to engineer new substances for inexpensive electronics and energy conversion devices. In this framework, we endeavor to have a large impact on the development of routes towards sustainable and renewable energy. To do this, we focus on systems (like polymer semiconductors and nanoparticles) that can be processed in solution and we study how to improve and optimize their optoelectronic properties using bottom-up nanotechnologies like chemical synthesis and self-assembly. We test the performance of the engineered systems in devices like thin-film transistors, photovoltaic diodes, and photoelectrochemical electrodes.

Methodology of work/special instrumentation

In our group, students have the opportunity to study materials synthesis (polymer and nanoparticle), device fabrication (thin film deposition techniques), and device testing. Synthetic organic chemistry (e.g. metal catalyzed cross-coupling reactions) is used to prepare conjugated (semiconducting) polymers, while solution-based techniques are used to prepare nanoparticles. Various chemical characterization techniques are used. To prepare devices, solution-based techniques (spin coating, doctor blading, and inkjet printing) are used in combination with physical vapor deposition (evaporation and sputtering). Electron microscopy and atomic force microscopy are used to characterize the nanostructure of the thin films. Device performance is characterized with standard current-voltage measurements, various potentiometric and galvanometric methods, any by analyzing the products of photoelectrochemical reactions.

Recent examples of MSc/PhD thesis

Maurin Cornuz, Master’s thesis (2009), “Water photoelectrolysis: Improvement of the hematite photoanode for tandem cell device.” (with the Laboratory for Photonics and Interfaces)