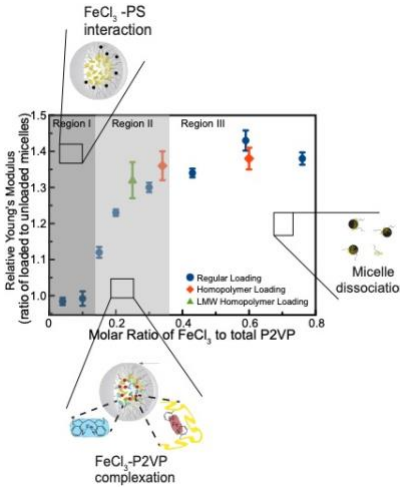
Concordia University
Concordia University
Arts and Science
Department of Physics

TURAK RESEARCH GROUP

Undergraduate research opportunity (Summer 2023/Fall 2023/Winter 2024)
Nanomechanical properties of micelles as a universal route to understanding nanoparticle formation
Department of Physics, Concordia University, Montreal Canada
Centre for NanoScience Research (CeNSR)

The Turak Functional Nanomaterials Laboratory seeks to revolutionize energy devices by making them cheaper, more accessible, and more flexible. Our research focusses on developing easy, versatile, and inexpensive methods of exploring and tuning surfaces using nanoparticle functionalization. To achieve this vision, the Turak group uses simple manufacturing approaches (reverse micelle deposition), allows nature to dictate morphology (entropic self-assembly, beneficial dewetting), and develops characterization tools.



Hanta, Turak et al. Colloids and Interfaces

Nanoparticles have been found to have an increasingly wide range of applications including drug delivery systems, chemical sensors, biomolecule sensors, single electron devices, catalysis, Li-ion batteries, and solar cells. A variety of methods have been used to produce nanoparticles, but one widely used approach is the application of reverse micelle nanoreactors whereby block co-polymers are used to encapsulate precursor salts and serve as a "nano-beaker" to allow for reactions in solution. The nanoreactor approach is particularly useful as parameters can be tuned to create a nanoparticle array with specific nanoparticle size and order on the substrate. As nanoparticle formation can be a multi-step process, some compositions have proven difficult to make within the reverse micelle nanoreactor. To fully understand the nanoparticle formation process, we developed a method to probe the internal structure of the reverse micelle, based on the quantitative mechanical mapping (QNM) mode for atomic force microscopy (AFM). This approach uses the change in the Young's modulus with salt incorporation as a quantitative stand-in metric for the resultant particle size and composition. This project will focus on confirming the universality of the QNM approach to tracking nanoparticle size and composition, by extending it to include different salts, different polymers and different loading conditions. This will enhancing the existing working theoretical description of the process.

In this project, the student will be expected to produce micelles with different polymers and different salt loadings, and test them with QNM-AFM and SEM to correlate the mechanical properties with the structure of the micelles, as well as XPS to confirm the composition of the nanoparticles. They will also perform some theoretical modelling of the mechanical properties of polymers to explain the results.

Students interested in paid (USRA, CURSA, Physics URA, FRQS Awards for Undergraduate Introduction to Research), for class credit (Honors thesis or research experience) or volunteer internships from Physics, Chemistry, Chemical and Materials Engineering, or related areas are welcome to apply.

To apply, please send a letter of interest, CV and contact information for two references in a single pdf document, with email subject **"Turak Lab Project Applicant"**. Only applicants considered for employment will be contacted for an interview. **All applications should be sent to Ayse Turak (ayse.turak@concordia.ca)**