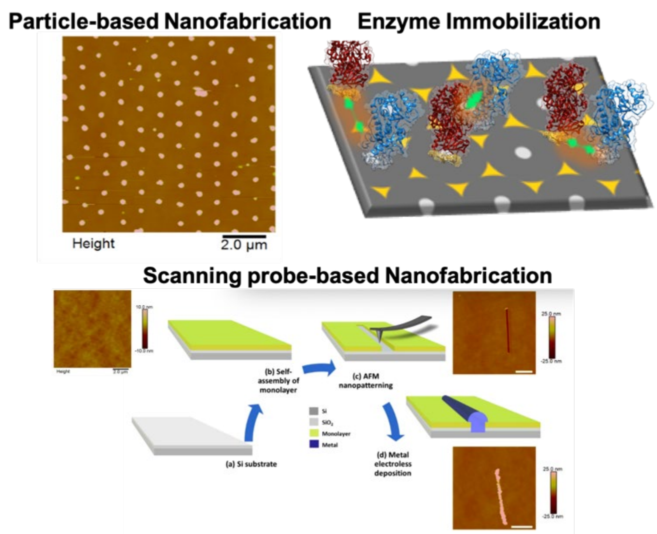
Nanoscale investigations at Interfaces: From biomaterials to electronics
Prof. Cindy L. Berrie

The Berrie group is investigating a variety of properties of materials interfaces at the nanoscale. We currently have multiple projects that an REU student could be involved in, including investigation of peptide and enzyme binding to nanostructured materials, the development of nanostructured materials platforms, or the application of microscopy methods for the investigation of electronic materials. We have developed nanofabrication methods that allow us to create precisely tunable arrays of metal nanostructures.[1-3] We are looking to expand this work to incorporate multiple metal patterns in spatial registry. These will serve as templates for the organization of enzymes using genetically engineered peptides to target specific materials. We have used this to investigate enzyme immobilization on gold surfaces and have shown control of the orientation and conformation of the enzymes can be achieved using these peptides at immobilization tags.[4-5] The organization of multiple enzymes at the nanoscale is critical for the development of biosensor and biocatalyst systems that often involve multiple enzymes working in concert. In this project, students would develop skills in sample preparation, nanoscale fabrication, and atomic force microscopy.



In other projects, we use similar methods to investigate the electronic properties of materials.[6-7] In photovoltaic devices, the efficiency of the device is often dominated by the interface properties, and therefore it is critical to understand how the structure of the interface effects the electronic properties. As electronic devices shrink further, it is critically important to understand the interfaces of this materials as well, and possibly rethink the materials that are used in such applications to include molecules with nanometer size as well as precise tunability of the electronic properties. We have several projects in this area which often involve collaborations with colleagues, including investigations of films of Prof. Barybin's azulene-based molecules. A major focus of this work has been to identify how the binding and organization of molecules at interfaces affects their electronic properties. The local conductivity and work function as well as the structural organization of the molecules is investigated through a combination of scanning probe-based methods combined with infrared spectroscopy and ellipsometry for film characterization. Students involved in these projects would develop skills in sample fabrication and characterization using a variety of thin film characterization methods including scanning probe-based methods as well as FTIR, ellipsometry, and contact angle measurements to characterization of the films. Prof. Berrie's research group has hosted more than 30 undergraduate researchers, many of whom have been coauthors on publications from their research and presented their work at local and national conferences.

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