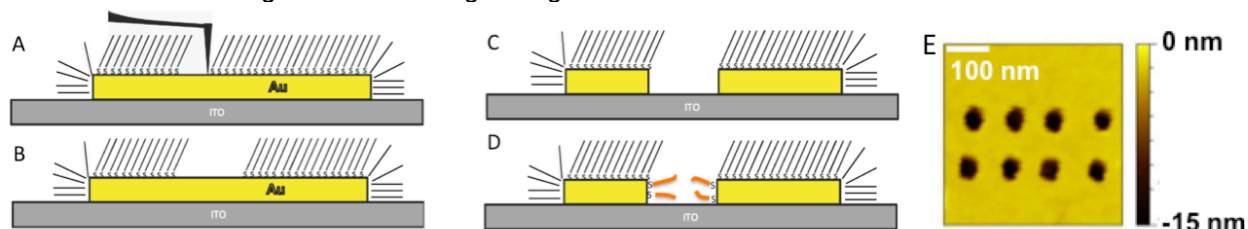


**Site-specific immobilization of DNA on single crystalline plasmonic structures. (Mentor: Tao Ye)** The fabrication of metallic nanostructures of controlled sizes and shapes is central to the development of plasmonics, which can manipulate light at the sub wavelength scale. Although existing lithographic methods, such as electron beam lithography and focused ion beam milling, can produce complex metal structures with a resolution of 10-20 nm, these techniques are expensive and require harsh conditions that are damaging to immobilized biochemical ligands, which are required for plasmonic biosensors. The Ye group has been exploring an inexpensive and biocompatible alternative, wet etching of noble metals with nanopatterned self-assembled monolayer resists. Although the resolution of wet etching was limited by lateral etching in the past, we have discovered a novel mechanism for anisotropic etching. Nanometer-sized holes can be etched in 20-60 nm thick single crystalline gold microplates with minimal lateral expansion (Figure 1).

This research project has components ideally suited for undergraduate researchers. *E.g.*, Adriana Lopez, is a coauthor of a recent publication in ACS Nano. The participating summer REU researcher will help develop a new method to selectively attach biochemical ligands to plasmonic hot spots. This is critically needed for detection of low copy number of biomarkers, as detectable signals mainly originate from the targets captured in the “hot spots” and targets captured else contribute little to the signals. The participating summer REU researcher will exploit the unique advantage of our novel wet etching approach for selective immobilization of DNA (Figure 1). He/she will learn to produce nanohole/gap structures in gold microplates supported on transparent indium tin oxide. Because the rest of the microplate is protected by a self-assembled monolayer, thiolated DNA will only be attached to the exposed sidewalls. The students will learn to use localized surface plasmon resonance spectroscopy to characterize the selective immobilization of the ligands and binding of targets.



**Figure 1:** Schematic of selective immobilization of biochemical ligands. A, B, a sharp atomic force microscope tip is used to selectively desorb an alkanethiol molecular monolayer grown on a gold microplate deposited on indium tin oxide. C, pattern transfer occurs during chemical etching under a thiourea solution under electrochemical control, creating small holes. D, because the sidewall is the only exposed area on the gold microplate, thiolated DNA can be selectively attached to the sidewall, where EM fields are enhanced. E, AFM image of the pattern produced on a gold microplate.