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Achieving Atomically Smooth Surfaces and Ultra Sharp Platinum-Iridium Tips for Deposition of Organic Molecules

College of Sciences and Health Professions

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Abstract

Organic materials are used in traditional solar cells and in flexible electronics. Unfortunately, the conductivities of organic semiconductors are significantly lower than their inorganic counterparts. This project examines the crucial first steps to enhancing the conductivities of these organic materials by crystallization via surface reconstructions. For this, the surface must be not only atomically smooth, but also atomically clean because there must be both enough room for the molecule to lie on and no possible adsorbates for the deposited material to react with. In this work, we looked at two substrates, gold and silicon. For the gold, we examined two annealing methods: hot plate and flame annealing. The hot plate method is the more viable, producing terrace widths of $\sim 150\text{nm}$, which is 50nm wider than achieved by flame anneal. For the silicon, a simple cleaving method in a nitrogen environment produced step edges of width $\sim 20\text{nm}$. These surfaces are characterized with Scanning Tunneling Microscopy (STM), however, atomic resolution has yet to be achieved in either case, possibly due to other adsorbates obscuring the surface. For the best STM images, we also need an atomically sharp, conductive tip. To achieve this, we used a two-step procedure for electrochemically etching platinum-iridium wire. The final step is a micro-polishing etch which utilizes H_2SO_4 to finely etch the tip down to exhibit radii of curvature of $70\text{-}100$ nanometers with completion determined visually. In order to improve on this process, we are currently developing a circuit that will electrically determine completion which will result in more reproducible tips.