NANOHOUR

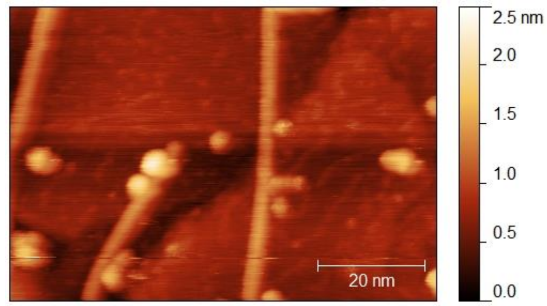
Wednesday, December 4, 2013 3:00 pm

Beckman Institute - Room 3269

Single Molecule Absorption detected by Scanning Tunneling Microscopy

Lea Nienhaus, Chemistry

Graduate Student with Professor Martin Gruebele



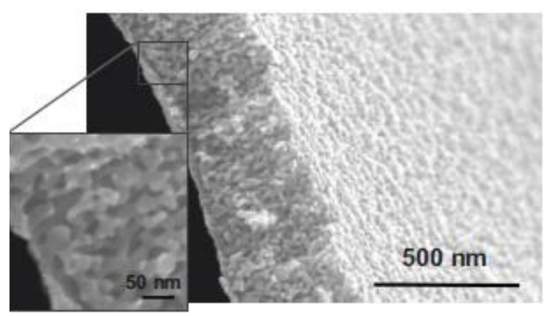
The high spatial resolution of the scanning tunneling microscope (STM) makes it a powerful tool to investigate single molecules deposited on a variety of conductive or semi-conductive surfaces. By adding the optical component, we are able to simultaneously examine single molecules with high spatial and spectral resolution. Our novel method of single molecule absorption (SMA) detected by scanning tunneling microscopy (SMA-STM) relies on backside illumination by a frequency modulated (FM) laser beam and total internal reflection (TIR). TIR causes an evanescent wave to propagate beyond the surface. The tip enhances this optical field by several orders of magnitude, exciting the molecules on the surface. Absorption results in a frequency dependent change in the local density of states (LDOS), probed by the STM. The resulting signal is detected by a lock-in amplifier (LIA), locked onto the laser modulation frequency. Although this approach for the most part overcomes junction heating effects, a new problem arises. It is no longer possible to use arbitrary substrates - apart from being atomically flat and conductive they must also be optically transparent at the wavelength of excitation. Previous studies involved absorption spectroscopy of carbon nanotubes (CNT) on silicon substrates. For further studies of SMA we have chosen molecules with a more defined absorption band in the visible region: organic fluorophores and quantum dots, using ultrathin metal films and graphene on sapphire as substrates.

Nanoporous Gold: Fabrication and Mechanics

Dr. Oya Okman, Beckman Institute

Post-Doctoral Research Associate with

Professor Nancy Sottos & Professor Scott White



Nanoporous gold (np-Au) is a versatile material due to its high surface area, chemical inertness and facile fabrication requirements. Its application areas include supercapacitors, fuel cells, catalysts, biological and chemical sensors, and micro actuators, among many. On the other hand, there exists some major fabrication issues that impact the quality and functionality of the np-Au based MEMS devices. Porous surface formation is a complex process that involves selective material removal from a single-phase alloy of gold and subsequent surface reconstruction. If the precursor film is constrained to a rigid substrate, such as silicon wafers, a residual film stress develops throughout the film, increasing the risk of cracking. The conventional fabrication methods often lead to extensive cracking of np-Au films adhered to stiff surfaces.

We acquire in-situ film stress measurements during formation of np-Au thin film from precursor Au-Ag alloy. We use a multi-beam stress sensor (MOSS) system integrated with an electrochemical cell. The results indicate that the films stress increases abruptly at the start of selective dissolution and there exist an intrinsic stress evolution trend for galvanostatic and potentiodynamic process control. The galvanostatic dealloying methods give superior film quality with short process time. With process optimization, constrained blanket np-Au films are produced up to 1300 mm thickness. Furthermore, using the same experimental set up, film stress variation is measured upon cycling surface charging. The results indicate a pronounced actuation of np-Au coated Si micro devices upon double layer charging.

Coffee and cookies will be served

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