My project is to design and fabricate a metal/semiconductor-insulator-metal/semiconductor heterojunction capable of transducing vibrational and electronic mode information about the properties of the enclosed interfaces. This micro-/nano-fabricated junction measures the fundamental frequencies of these discrete modes by "illuminating" the heterojunction with a tunneling electron stream with a well-defined energies and the scattering of these electrons from the vibrating bonds in the molecule is extracted from the measured current, as a function of the electronic energy. It enables the development of an all-electronic "spectroscopic" tool for the characterization of these mesoscopic junction interfaces. A suitable target analyte will be “sandwiched” within the heterojunction such that its electronic and vibrational frequencies will also be elucidated from the tunneling current information, thereby enabling the development of an all-electronic nose for sensing odorant molecules of interest.

The test prototype for the “e-nose” concept will be built using the conductive AFM (cAFM) platform, where the nanoscale tip of the force microscope will be used as the top metal contact for the nanoscale heterojunction structure. Besides extracting tunneling current information, we will utilize additional capabilities of the AFM like the sample topography, surface potential and interactive force between tip and surface, to characterize the junction interfaces. Additional surface analysis tools like SIMS and XPS may also be employed to characterize the fabricated junctions. The cAFM may also be employed for the fabrication of the interface using local electric fields and thermal gradients for nanoscale patterning.

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Conference presentations:

2014.03 “Using STM sip as electrochemical sensor for the characterization of bond vibration frequencies of a chemical analyte” , American Physical Society March meeting in Denvor

2011. 04 NHGRI Advanced Sequencing Technology Grantee Meeting.

2011.03 “Electronic Signatures of all Four DNA Nucleosides in a Tunneling Gap”

American Physical Society March meeting in Dallas

2009.03 “Chemical Recognition Tunneling via Hydrogen Bond”

American Physical Society March meeting in Pittsburgh

2008.03 “Tunneling readout of hydrogen-bonding based recognition”

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