Study of Semiconductor Clusters by Local Inverse Photo Emission

Dror Sarid
Optical Sciences Center
University of Arizona
Tucson, AZ 85721
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We have completed the project of building the first system consisting of a scanning tunneling microscope operating in ultra-high vacuum, and all the components, shown in Figure 1, are now operational. STM images of charge-density waves in UHV have been successfully obtained, as shown in Figure 2. We have developed and operated two other systems that enable us to perform the task delineated in the original ONR proposal. The second system is a computerized nanolithography station where computer generated patterns drive the STM tip, which deposits atoms at the pre-prescribed locations, as shown in Figure 3. The third system measures the photon emission from nanostructures using a cooled photomultiplier, a photon counter, and an image processor, as shown in Figures 4-6. We are currently writing several papers that describe the theory of photon emission from STM-deposited patterns and the various experiments performed with these three systems. Enclosed is a list of publications describing our STM work. Future plans call for the refinement of the experiments where clusters are written and their light emission recorded and analyzed topographically and spectroscopically.
STM Publications

Semiconductors and Surfaces


Instrumentation and Theory


**Review**


**Biology**


Figure 1. The experimental system comprising of: (1) UHV chamber, (2) preparation chamber, (3) LEED, (4) Auger, (5) three Knudsen cells, (6) electron heating, (7) cleaving, (8) mass spectroscopy, (9) sputtering, and (10) scanning tunneling microscopy.
Figure 2. STM image of charge-density waves on TaS$_2$ crystal in UHV.
Figure 3. Nanolithography with gold tip and a crystalline gold sphere showing an STM image of an array of dots.
Figure 4. An STM image of a single gold structure.
Figure 5. An image due to photon emission from the structure of Figure 3 using the STM.
Figure 6. The spectroscopy of the photon emission using the STM.