Multi Component Functional Nanostructures by Ferroelectric Nanolithography

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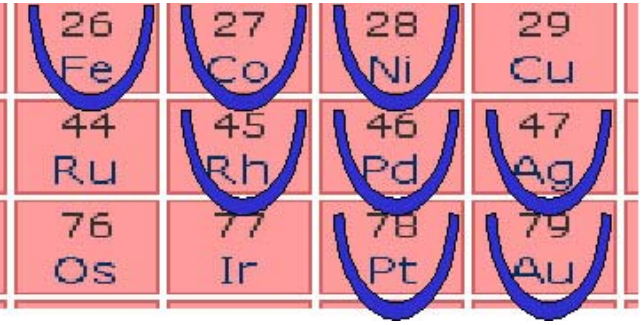
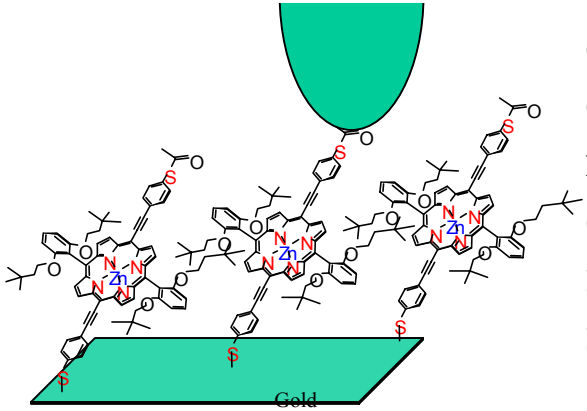
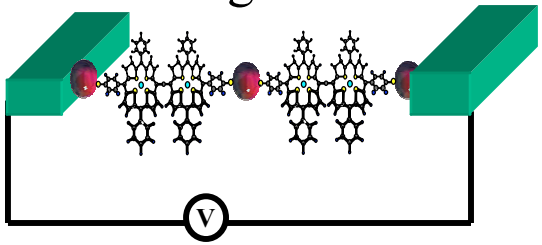
Ferroelectric nanolithography is a new approach that utilizes the effect of atomic polarization in ferroelectric compounds on surface electronic structure to produce multi component nanostructures. One class of reactions is photoreduction of metal based nanoparticles. Reaction pathways for the elements shown in the table below have been determined. These include catalytic and magnetic particles as well as nanoelectrode materials.



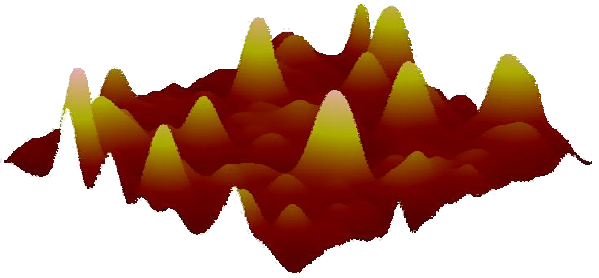
Vertical Configuration



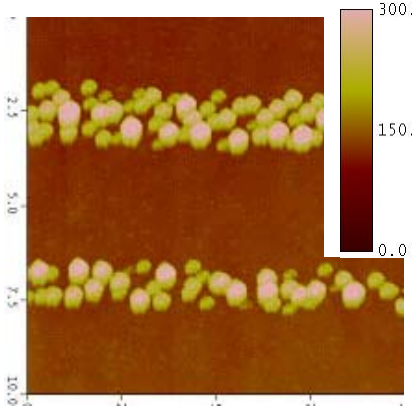
Horizontal Configuration



Ferroelectric nanolithography has been used to produce composite structures in two configurations. Current image obtained in Scanning tunneling microscopy showing the electronic structure of individual porphyrin molecules in the vertical configuration.



Topographic image obtained by atomic force microscopy shows Ag nanoparticles patterned laterally to which porphyrin molecules are attached.



Controlled Fabrication of Nano-Gaps for Molecular Electronics

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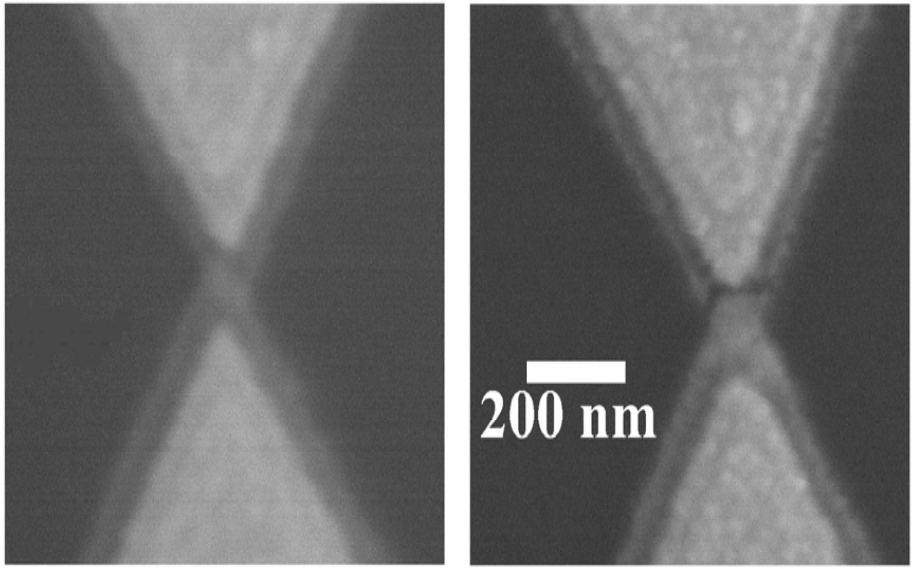

Critical to the utilization of nanomaterials is the routine characterization of the properties of individual nanostructures. We have developed a new process to make electrodes with controlled nano-gaps for electronic measurements of molecules that can be done reproducibly at room temperature and in ambient environment.

The left scanning electron microscope image shows a continuous gold lead and the right one shows a nano-gap made with our controlled electromigration method in an ambient lab environment. A comparison of the I/V response before and after exposure to porphyrin molecules shows that the molecule spanning the gap decreases the resistance significantly.