

SW-P013

Controlling Spin State of Magnetic Molecules by Oxygen Binding Studied Using Scanning Tunneling Microscopy

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Binding and unbinding between molecular oxygen and metallo-porphyrin is a key process for oxygen delivery in respiration. It can be also used to control spin state of magnetic metallo-porphyrin molecules. Controlling and sensing spin states of magnetic molecules in such reactions at the single molecule level is essential for spintronic molecular device applications. Here, we demonstrate that spin states of metallo-porphyrin on surfaces can be controlled over by binding and unbinding of oxygen molecule, and be sensed using scanning tunneling microscopy and spectroscopy. Kondo localized state of metallo-porphyrin showed significant modification by the binding of oxygen molecule, implying that the spin state was changed. Our density functional theory calculation results explain the observations with the hybridization of unpaired spins in d and π^* orbitals of metallo-porphyrin and oxygen, respectively. Our study opens up ways to control molecular spin state and Kondo effect by means of molecular binding and unbinding reactions on surfaces.

Keywords: Scanning Tunneling Microscopy, Scanning Tunneling Spectroscopy, Kondo Effect, metallo-porphyrin, oxygen

SW-P014

Strain relaxed Co nanocrystals formation from thin films on sapphire substrate induced by nano-second laser irradiation

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We report the phase transformation of Co thin films on a sapphire substrate induced by laser irradiation. As grown Co films were initially strained and tetragonally distorted. With low power laser irradiation, the surface was ruptured and irregular holes were formed. As the laser power was increased, the films changed into round shape Co nanocrystals with well-defined 6-fold structure. By measuring the XRD of Co nanostructure as a function of laser energy densities, we found that the change of morphological shapes from films to nanocrystals was accompanied with decrease of the tetragonal distortion as well as strain relaxation. By measuring the size distribution of nanocrystals as a function of film thickness, the average diameter is proportional to 1.7 power of the film thickness which was consistent with the prediction of thin film hydrodynamic (TFT) wetting theory. Finally, we fabricated the formation of size controlling nanocrystals on the sapphire substrate without strain.

Keywords: nanocrystals, laser irradiation, X-ray diffraction

