UCLA College | Physical Sciences Chemistry & Biochemistry

PHYSICAL CHEMISTRY SEMINAR

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Monday, May 10, 2021
4:00 PM
via Zoom

"Taking Electron Spin Resonance to the Single Atom and Molecule"

Scanning Tunneling Microscopy (STM) can be combined with electron spin resonance (ESR). The major advantage of spin resonance is the fact that the energy resolution is independent of the temperature and thus can be much higher than a Fermi-function limited spectroscopy technique such as STM tunneling. In ESR STM we apply a microwave-frequency electric field to the tunnel junction and convert this AC electric field into a coherent driving field for ESR. We find an energy resolution in ESR STM which is about 10,000 times better than low-temperature STM.

We will start by introducing the basic concepts of STM as well as ESR to bring everyone up to speed. Then we will focus on two examples, one based on spin 1/2 atoms and one on spin ½ molecules, both on MgO on Ag(100). First, Ti atoms on this surface always have a H atom attached, which leads to a d1 electronic configuration. Together with the ligand field of the MgO, it results in a S=1/2 spin. We will explore the use of Ti-H as a quantum sensor to probe its immediate environment.

In the second example we will explore the first extension of this young technique to the study of molecules. By accident, we found that Fe-Pc molecules on MgO have a different spin state than in vacuum. On MgO they take one additional electron and present as a S=1/2, the first molecule that can be probed by ESR STM. Despite the fact that both at S=1/2, the spin properties are quite different from Ti-H which leads to an interesting spatial dependence of the molecule-molecule spin interaction.

ESR STM is just in its infancy with many groups joining this research effort. I believe that this technique will occupy a bright corner of quantum-coherent nanoscience.

Please contact marla@chem.ucla.edu for additional information.