

Theory of Condensed Matter: Hard Condensed Matter

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Spin detection and doping of metallocenes on copper substrates

The main subject of this presentation will be the study of metallocenes deposited on copper surfaces. Their adsorptions and electronic properties are experimentally studied by scanning tunnelling microscopy (STM) and scanning tunnelling spectroscopy (STS). Our results were confirmed by density functional theory (DFT) computations.

More precisely, we studied how ferrocene $\text{FeC}_{10}\text{H}_{10}$ and nickelocene $\text{NiC}_{10}\text{H}_{10}$ are adsorbed on copper. We found that these metallocenes spontaneously create networks alternating horizontal and vertical molecules. We added a cobalt atom to the ferrocene in order to modify its structure and we characterized the magnetic properties of the new molecule we created, in particular the appearance of a Kondo effect showing that magnetic properties appeared in the molecule.

The spectroscopic study of nickelocene revealed an excitation of the molecule at low bias. This excitation consist in a change in the spin orientation of the molecule, going from an orientation perpendicular to the main molecule axis to an orientation parallel to this axis. We finally transferred a nickelocene to the STM tip and used this molecular tip to probe the states of a second molecule. We consequently obtained a double spin excitation in our tunnel junction, with a significant increase of the conductance due to excitations.