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Guest Lecture

Title:

"Realizing the Smallest Surface Adsorbed Quantum Magnets"

Speaker: Prof. Dr. Harald Brune

Address: École Polytechnique Fédérale de Lausanne EPFL, Laboratory of Nanostructures at Surfaces; Switzerland

Date: Friday, 21st of October 2016
Time: 14:30
Place: Seminar Room CBEG02 (387, Photonics); Gußhausstraße 27

Abstract: The magnetic states of nanostructures are of high interest for information storage and quantum information processing. This has triggered the search for the smallest possible magnets. In devices, electrodes have to be attached to them for readout and manipulation of the magnetic quantum states. This corresponds to their adsorption onto conducting surfaces.
Possible candidates for the smallest surface adsorbed magnets are molecules and small metal clusters down to the ultimate size limit of single metal adatoms. The benchmarks for quantum magnets are their magnetic relaxation and coherence times, T1 and T2. The first determines how long information can be stored in a magnetic quantum state, and the second defines the time one has to take out a quantum computation step.
Many molecular magnets that exhibit promising properties in bulk samples loose thementirely when they are surface adsorbed, and all single metal adatoms reported so far are perfect paramagnets, despite their high magnetic anisotropies [1]. This is predominantly due to scattering with metal conduction electrons. In the case of molecules, conformational changes induced by surface adsorption may add to it. Finally, for higher temperature, phononinduced magnetization reversal starts to override electron scattering.
We show that these problems can largely be overcome by using oxide, graphene, and hexagonal boron-nitride spacer layers that significantly enhance the magnetic

lifetimes of the surface adsorbed species as compared to direct adsorption onto a metal substrate. Pc2Tb double-decker molecules adsorbed on MgO(100) thin films grown on Ag(100) have much longer spin-relaxation time and wider hysteresis than in bulk samples [2]. Ho atoms on the same surface are the first single atom magnets [3]. They exhibit spin-relaxation times of an hour at 2 K and display hysteresis up to 30 K, thus outperforming best molecular magnets.

[1] I. G. Rau et al., Science 344, 988 (2014).
[2] C. Wäckerlin et al., Adv. Mater. 28 5195 (2016).
[3] F. Donati et al., Science 352 318 (2016).