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TÉMA

Engineering spin structures at the atomic scale

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The downscaling of magnetic memory units and operational devices will soon call for functional structures with atomic precision of their architecture. But the behavior of the magnetic moments of impurities adsorbed on a metal surface is strongly influenced by the electronic properties of the contacting lead. Therefore, the comprehension of interactions between atomic spins and its solid state environment, which can be either the conduction electron continuum of the metal host, other neighboring magnetic moment adsorbed on the surface or the nearby atoms of the substrate, is a fundamental step towards the realization of the technology based on the spin degree of freedom. Since the irruption of the scanning tunneling microscopy (STM) and its different implementation modes such as scanning tunneling spectroscopy (STS) or spin polarized scanning tunneling microscopy (SP-STM), the study of spin-spin interactions at ultimate length scale is accessible. Artificially engineered Co structures built atom by atom, by means of atomic manipulation technique, adsorbed on a Ag(111) metal surface and on a Mn/W(110) metal surface with non collinear magnetic ground state have allowed us the comprehension of different interaction mechanisms between single spins and its foremost environment.

We have chosen Co/Ag(111) as a model system to study the influence of the host LDOS in the Kondo effect of Co atoms. In this system, we find that the relevant energy scale of the Kondo effect, the Kondo temperature (TK), strongly depends on the contacting lead LDOS at the Fermi level. This entails that the coupling strength between a magnetic impurity and its foremost environment can be tuned through the electronic properties of the metal host at wish, leading to important fundamental and technological implications.

Single Co atoms placed at designated positions over the Mn monolayer on W(110) display an apparent shape and height strongly dependent on their spin direction. Working on this substrate we can obtain direct evince of each atom's spin state by means of spin-polarized STM topography images. We have built up Co chains over the Mn monolayer on W(110) and monitored the changes of the spin magnetic moment of the atoms, to investigate competing exchange interactions between the Co atoms forming the chains and the Mn atoms of the magnetic substrate.

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