Poster

RESPONSE OF Mn OVERLAYERS ON Fe SUBSTRATE TO EXTERNAL MAGNETIC FIELDS

Eduardo Martínez[1], *Huahai Tan*[1], *Andrés Vega*[2], *Roberto Robles*[3] *and Valery Uzdin*[4]

[1] *Fachbereich Physik, Universität Osnabrück, Osnabrück, Germany*
[2] *Departamento de Física Teórica, Atómica y Óptica, Universidad de Valladolid, Valladolid, Spain*
[3] *Department of Physics, Virginia Commonwealth University, Richmond, VA 23284, USA*
[4] *St. Petersburg State University, Universitetskaya nab. 7/9, St. Petersburg, Russia*

Email: edmartin@uos.de

The magnetism of a large variety of nanostructures has been investigated in the last decades from both the experimental and theoretical sides [1]. The full understanding of the magnetic properties of a given system requires not only knowing its intrinsic properties but also its response to external fields. Moreover, many of the technological applications on magnetism are based on the possibility of engineering the system by applying external fields [2]. Experimentally, increasing the level of locality of applied fields is a challenge which will improve the density of information storage in recording media and consequently the device miniaturization. Most of the previous studies concentrated on collinear magnetism, which does not allow the local magnetic moments to rotate freely. Here we employed a semiempirical Tight-Binding method [3,4,5,6], which allows calculations in systems with large inequivalent sites within a noncollinear framework and includes the interaction with external magnetic fields. The system we studied is composed of 6 Mn overlayers deposited on a Fe substrate. In the collinear framework, we obtained various couplings in Mn overlayers. As a general trend, we found that those metastable configurations energetically close to the ground state have antiparallel couplings between Mn surface and subsurface layers as well as between Mn layers adjacent to the Fe interface, and a parallel coupling at the Mn/Fe interface. The hysteresis loop in the collinear case shows both smooth and sharp changes of the average magnetic moment of the Mn slab depending on the external field. The smooth changes correspond to reversible variations of a magnetic configuration of the system while the sharp changes are the result of a magnetic transition to a configuration with different local exchange couplings. In contrast, a reversible cycle is obtained in the noncollinear framework for the full range of applied fields. Therefore the response of the system is markedly different in both approaches. Due to the non-reversibility obtained in the collinear framework, the external magnetic field can be used to switch the system between different metastable configurations, some of them having very different average magnetic moment. We have found that the magnetic couplings in the central layers are weaker than those at the interface region and at the surface.

References:

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