In-plane magnetic anisotropy in Fe/MgO/GaAs(001) system

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Interest in a ferromagnet (FM)/semiconductor (SC) system has increased significantly over the last two decades due to the emergence of the field of spintronics [1]. The efficiency of the spin injection from a metallic FM layer into a SC layer is usually very low due to the conductivity mismatch [1]. This difficulty can be overcome by inserting an insulating tunneling layer at the FM/SC interface [2]. Therefore, Fe/MgO/GaAs(001) could also be a promising candidate for future spintronic devices. The spin injection in an FM/SC system should be very sensitive to interface properties, so in order to further manipulate the spin injection in a Fe/MgO/GaAs(001) system, it is essential to understand the magnetic properties in Fe/MgO/GaAs(001) with an ultrathin MgO interlayer.

In this work, the in-plane magnetic anisotropy of Fe/MgO/GaAs(001) system has been carefully studied as a function of MgO thickness. The epitaxial relation is Fe(001)[110]//MgO(001)[100]//GaAs(001)[100] for d_{MgO}>1 monolayer (ML). The interfacial uniaxial anisotropy was greatly

reduced by the MgO interlayer, and the easy axis of the fourfold anisotropy was found to rotate from the GaAs<100> direction to the GaAs<110> direction. Such anisotropy transition happens within the 1.2 ML MgO thickness range.

Our results may benefit the design of spintronics devices based on the Fe/MgO/GaAs(001) system.

References:

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