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Publication Date
2009-11-01

Thickness dependence of x-ray linear dichroism in NiO thin film grown on Fe(001) surface

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Studying on the exchange interaction between ferromagnetic(FM) and anti-ferromagnetic (AFM) materials has attracted great interest, due to the attempt to understand the mechanism of exchanged bias effect, which is important for magnetic device application. NiO/Fe bilayer is a model system to study such exchange coupling since the NiO AFM properties can be studied directly by x-ray magnetic linear dichroism(XMLD). Interestingly, Finazzi et al[1,2] recently reported their study on magnetic instabilities in NiO thin films epitaxially grown on Fe(001), and they found a clear sign reversing of XLD effect at ~2nm NiO using photoemission electron microscopy(PEEM) method. Such transition indicates that thin NiO films show a sudden phase transition from an in-plane collinear (low NiO thickness) to a perpendicular (high NiO thickness) coupling between the NiO anisotropy axis and Fe magnetization[3]. However, the mechanism of the easy axis switching of NiO AFM anisotropy is still not so clear, which requires careful study on the thickness dependence of XMLD effect for NiO film grown on Fe(001).
In this contribution, we carefully studied the linear dichroism in NiO/Fe(001). By the thickness dependence measurement, the linear dichroism was found has a sign change around 2nm NiO thickness, which is consistent with the previous study. Strong linear dichroism was obtained even for 1ML NiO at room temperature. Such XLD effect can exist up to 525K which is higher than the bulk NiO Neel temperature(520K). Such sign change of XLD effect can also exist for a 8ML Ag interlayer inserting between NiO and Fe(001). Our results obviously prove that a large portion, if not all, of the XLD effect in NiO/Fe(001) system may not come from the NiO AFM order and NiO/Fe interface properties, but it is related the magnetic properties of Fe film. The possible origin of the observed linear dichroism is the magnetic restriction in Fe film.

Supported by the U.S. Department of Energy under Contract No. DE-AC02-05CH11231.

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