

## Magnetic properties of ferromagnetic–antiferromagnetic bi–layers with different spin configuration

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We investigated the effect of different spin direction of anti-ferromagnetic layer on the magnetic properties of ferromagnetic layer in Fe-NiO and Fe-CoO bi-layer systems. For Fe-NiO system, we prepared the clean MgO(001) surface half-covered with 20 nm Ag films as a substrate for magnetic layers. Then we grew NiO wedge layers on the substrate, and added 8 monolayer(ML) Fe layers on the wedge layer. We examined magnetic properties of the bi-layer system using the surface magnetic optical Kerr effect(SMOKE) and X-ray magnetic linear dichroism(XMLD). From SMOKE measurement we observed the coercivity enhancement due to the set-up of anti-ferromagnetic order of NiO films in both of the Fe/NiO/MgO(001) and Fe/NiO/Ag/MgO(001) system. The most remarkable results in our observation is that the coercivity enhancement of Fe/NiO/Ag/MgO(001) is much larger than that of Fe/NiO/MgO(001). XMLD experiments confirmed the out-of-plane spin direction of NiO layers in Fe/NiO/MgO(001) and in-plane spin-direction of NiO layers in Fe/NiO/Ag/MgO(001), and we concluded that the origin of large enhancement of coercivity is due to the strong parallel coupling between Fe layers and NiO layers. We also confirmed that this strong parallel coupling maintained across the thin Ag layer inserted between Fe and NiO layers. For Fe-CoO system, we prepared Fe/CoO/Ag(001) and Fe/CoO/MnO(001) systems and observed much larger coercivity enhancement in Fe/CoO/Ag(001).

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