Magnetic domains studies in wedged Fe/Ti/Fe trilayers

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20nm-Fe/d_{Ti}-Ti/20nm-Fe trilayers with wedged Ti sublayers were prepared at room temperature using UHV (5×10^{-10} mbar) RF/DC magnetron sputtering. As a substrate we have used Si(111) wafers with an oxidised surface. The chemical composition and the cleanness of all layers was checked *in-situ*, immediately after deposition, transferring the samples to an UHV (4×10^{-11} mbar) analysis chamber equipped with X-ray photoelectron spectroscopy (XPS). From the exponential variation of the XPS Fe-*2p* and Ti-*2p* integral intensities with increasing layer thickness we conclude that the Fe and Ti sublayers grow homogeneously during the deposition processes of Fe/Ti and Ti/Fe bilayers. The magnetic characterisation of the samples was carried out using the magnetooptical Kerr effect. The observation of magnetic domains and walls were carried out at room temperature using the high-resolution longitudinal Kerr effect with digital image processing.

In the case of the wedged trilayers, the bottom Fe layer was deposited on rather rough Ti buffer layer. Such a layer showed greater coercivity compared to the top Fe layer deposited on quasi-amorphous Ti-Fe interlayer. For a sufficiently small Ti-Fe thickness the exchange coupling energy of the Fe layers across paramagnetic spacer is large enough for simultaneous magnetisation reversal process of the bottom and top sublayers. For a week exchange coupling ($d_{Ti} > \sim 2$ nm) we have observed a step-like hysteresis. The observed two significantly different coercive fields, H_{c1} and H_{c2}, are originated from the soft and hard magnetic Fe layers, respectively. Results on the systematic coercivity studies as a function of the Ti interlayer thickness for the wedged trilayers allow us to characterise the week interlayer exchange coupling of the Fe sublayers.

The hysteresis measurements showed that in our case the Fe layers are weakly ferromagnetically (FM) coupled for ~ 3.5 nm $> d_{Ti} > \sim 2$ nm. The above behaviour was also revealed by systematical domains observation during the magnetisation reversal process in a magnetic field equal to H_c. For Ti layer thickness in the range 0 – 2 nm we have observed large domains, characteristic for the strong FM exchange coupling. For greater Ti layer thickness we have observed smillar domain images. Such domains are characteristic for FM exchange coupling of the Fe sublayers. Above $d_{Ti} > 3.5$ nm a progressive transition to large independent domains takes place. The above behaviour could be explained by the existence of a week FM coupling for Ti layer thickness between 2 and 3.5 nm. The small decoupling Ti thickness could be explained by spontaneous formation of a quasi-amorphous structure of the paramagnetic spacer during the deposition process.

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