MAGNETIC PROPERTIES OF NANOCRYSTALLINE Co/Ti AND Co/Zr MULTILAYERS

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9.7 cm

The Co/Ti and Co/Zr multilayers (MLs) with constant-thickness and wedge shaped sublayers were prepared using an UHV (5×10^{-10} mbar) DC/RF magnetron sputtering. The chemical composition and the cleanness of all layers was checked in-situ, immediately after deposition, transferring the MLs to an UHV (4×10^{-11} mbar) analyse chamber equipped with AES and XPS. From the exponential variation of the XPS Co-2p, Zr-3p and Ti-2p integral intensities with increasing layer thickness we conclude that the Co, Zr and Ti sublayers grow homogeneously. The intense satellite peaks in the small angle X-ray diffraction patterns revealed the artificial periodicity of the MLs. We showed that below the critical Co thickness (d), the Co/Zr (d $\approx$ 2.8nm) and Co/Ti (d$\approx$ 3nm) MLs are magnetically soft and exhibit a saturation magnetisation higher than that observed in conventional soft magnetic films. It has been found, that below this thickness, Co-sublayers undergo a transition from the polycrystalline structure with the average Co grain size D>10 nm to the soft magnetic nanocrystalline structure with D<<10 nm. The Co sublayers are very weakly exchange coupled or decoupled for d_{Ti} >2nm and d_{Zr} >3nm. The rapid decrease of the interlayer exchange coupling could be explained by its strong damping due to formation of a non-magnetic quasi-amorphous Co-Ti (Co-Zr) alloy layer at the interfaces. The nanocrystalline Co/Ti MLs with d_{Co}=2.2nm showed a weak 90^o coupling near the transition zone from ferromagnetic to zero coupling.

13.4 cm

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