

Interlayer exchange coupling in Nb/Fe multilayers

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The (110) oriented Nb/Fe multilayers (MLs) with constant Fe (2 nm) and variable Nb sublayer thicknesses were prepared at room temperature using UHV magnetron sputtering. Growth of the Nb-Fe bilayers were studied in-situ by X-ray photoelectron spectroscopy (XPS). From the exponential variation of the XPS Fe-2p and Nb-3d integral intensities with increasing layer thickness we conclude that the Fe and Nb sublayers grow homogeneously in the planar mode. The artificial periodicity was revealed by intense satellite peaks in the low - and high - angle X-ray diffraction patterns. Magnetic hysteresis loop measurements at 5 K revealed antiferromagnetic (AFM) exchange coupling peak of the Fe sublayers near Nb spacer thickness of about 3, 5, 8 and 10 monolayers. Furthermore, above 200 K we have observed additional AFM peaks near Nb spacer thickness of about 13 and 15 monolayers. The Nb spacer thicknesses corresponding to the positions of the local AFM peaks slightly increase at 300 K. In general, the experimentally determined positions of AFM peaks at 5 K are in good agreement with ab-initio calculations with localized spin density and a generalized gradient approximations of exchange-correlation potential.