Probing antiferromagnetism in NiMn/Ni/(Co)/Cu₃Au(001) single-crystalline epitaxial thin films

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— Antiferromagnetism of equi-atomic single-crystalline NiMn thin film alloys grown on Ni/Cu₃Au(001) is probed by means of magneto-optical Kerr effect (MOKE). Thickness-dependent coercivity enhancement of NiMn/Ni/Cu₃Au(001) showed that 7 atomic monolayers (ML) NiMn order antiferromagnetically at room temperature. It is found that NiMn can couple to out-of-plane (OoP) as well as in-plane (IP) magnetized Ni, the latter stabilized by Co under-layer deposition. The antiferromagnetic (AFM) ordering temperature (T_{AFM}) of NiMn coupled to OoP Ni is found to be much higher (up to 110 K) than in the IP case, for otherwise identical interfacial conditions. This is attributed to the ‘magnetic proximity effect’ in which the ferromagnetic (FM) layer substantially influences the T_{AFM} of the adjacent AFM layer and can be explained by either (i) a higher interfacial coupling strength or/and (ii) more thermally stable NiMn distorted spin structure when coupled to Ni magnetized in OoP direction than in IP. An exchange-bias effect could only be observed for the thickest NiMn film studied (35.7 ML); the exchange-bias field is higher in the OoP exchange-coupled system than in the IP one due to the same reason/s.

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