Detection of antiferromagnetic moments in Heusler-type ferromagnet/antiferromagnet epitaxial bilayers

ホイスラー合金強磁性体／反強磁性体エピタキシャル積層膜における反強磁性磁気モーメントの検出

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Antiferromagnets (AFMs) show great potential to replace ferromagnets (FMs) in spintronic applications. Compared with FMs, AFMs have the advantages of much faster spin dynamics, more stability against charge and external field perturbations, and no stray field [1]. However, since the AFM spins align in alternating directions of magnetic moments on individual atoms, the resulting zero net magnetization makes hard to control AFM magnetic moments. Recently, there have been several reports regarding the control of AFM moments by applying an external field via the exchange-spring effect of FM on AFM in tunneling anisotropic magnetoresistance (TAMR) stacks [2]. In this presentation, we report the detection of AFM moments in Heusler-type FM/AFM Fe_2CrSi/Ru_2MnGe epitaxial bilayers using current-in-plane (CIP) configurations.

Figure 1 presents the magnetoresistance (MR) curves of Fe_2CrSi/Ru_2MnGe bilayers, where the bilayers annealed at T = 375 K (above Néel temperature of Ru_2MnGe) with applying field of + 10 KOe along [010] direction and, then cooled to T = 4 K with applying field of + 10 KOe along [010] direction. Although the symmetric MR curves similar to the typical FM AMR are obtained along H // [110] and [-110] parallel to the hard axes of Fe_2CrSi magnetocrystalline anisotropy, the asymmetric MR curves are obtained along H // [100] and [010] parallel to the easy axes of Fe_2CrSi. The maximum MR ratio ~5.9% is more than an order of magnitude larger than that of single-layer Fe_2CrSi films. The asymmetric curves indicate the partial AFM rotation resulting from the reorientation of AFM spins via the FM rotation. These results indicate that CIP magnetotransport measurements in FM/AFM bilayer provide a facile approach to detect AFM moments. At the presentation, we would like to discuss the origin of the MR effect.

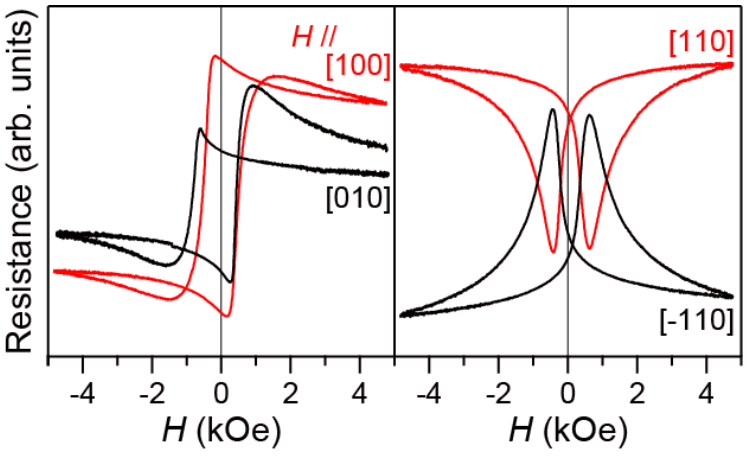

Fig. 1. Applied-field direction-dependent Magnetoresistance of Fe_2CrSi(5 nm)/Ru_2MnGe(20 nm) bilayers at T = 4 K.

[1] H. V. Gomonay and V. M. Loktev, Low Temp. Phys. **40**, 17 (2014).
[2] B. G. Park *et al.*, Nat. Mater. **10**, 347 (2011).