Temperature dependence of in-plane anisotropic magnetoresistance in (Ga,Mn)As:Li

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We reported the temperature dependent direction of in-plane uniaxial magnetic anisotropy in (Ga,Mn)As:Li by magnetization, ferromagnetic resonance, and magnetotransport measurements [1]. In this work, we investigate the temperature dependence of in-plane anisotropic magnetoresistance (AMR) in (Ga,Mn)As:Li and find that the change of the sign of the AMR is accompanied by the change of the sign of the uniaxial anisotropy.

A 20 nm-thick $Ga_{0.9}Mn_{0.1}As:Li_{0.01}$ is grown by molecular beam epitaxy on a semi-insulating GaAs (001) substrate. The sample is annealed at 250°C for 1 hour in the air, and its Curie temperature is ~145 K determined from the temperature dependence of magnetization. The sample is processed into a Hall bar along [110] orientation to measure longitudinal (sheet) and transverse (planar Hall) resistance, R_{sheet} and R_{Hall}, simultaneously, as functions of the magnitude and the direction of in-plane magnetic fields.

Figure 1 shows the magnetoresistance ratio, MR, under in-plane magnetic fields H parallel and perpendicular to the current I at (a) 10 K and (b) 110 K. The MR is anisotropic, and larger resistance is observed for $H \parallel I$ at 10 K, while for $H \perp I$ at 110 K. The temperature dependence of the AMR shows that the temperature ~75 K at which the sign crossover occurs coincides with the temperature at which the sign crossover of the uniaxial anisotropy takes place. We do not observe the sign change of the planar Hall resistance, despite that the AMR and planar Hall effects are believed to share the same origin.

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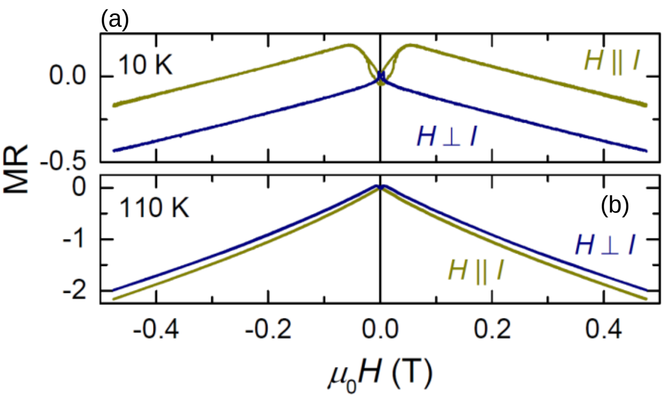

Figure 1: Magnetoresistance ratio, MR, under in-plane magnetic fields H parallel and perpendicular to the current I at (a) 10 K and (b) 110 K.

Reference

[1] S. Miyakozawa, L. Chen, F. Matsukura, and H. Ohno, Appl. Phys. Lett. **104**, 222408 (2014).