Ferromagnetic Resonance Studies of (Ga,Mn)N

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Dilute ferromagnetic semiconductors, in particular (Ga,Mn)N predicted to have an exceptionally high Curie temperature (T_C), have attained great research importance due to their unique ability to combine the properties of semiconductors and magnetic materials [1]. Moreover, GaN being a wide band gap semiconductor has been dominating the photonics [2] and high power electronics. So it is important to make an effort to understand the underling magnetic properties of (Ga,Mn)N.

We report ferromagnetic resonance (FMR) studies of a series of (Ga,Mn)N layers grown by molecular beam epitaxy [3,4]. All investigated samples showed ferromagnetic signatures, as evidenced by SQUID magnetometry, with T_C ranging from 3 to 12 K. A broad angularly dependent FMR signal appears only at higher temperatures, closer to and above T_C, with intensities roughly scaling with magnetic susceptibility of the material, as shown in Fig, 1. However, apart from a very weak paramagnetic signal of Mn^{2+}, no ferromagnetic resonance is observed below 7 K, *i.e.*, where such ferromagnetic features as the hysteresis of magnetization curves and the remnant moment are the strongest. We relate this counterintuitive lack of low temperature FMR signal to inhomogeneous broadening caused by non-uniform distribution of magnetic ions and thus inhomogeneities in coupling strengths influencing the local magnetic anisotropies of Mn^{3+} ions.

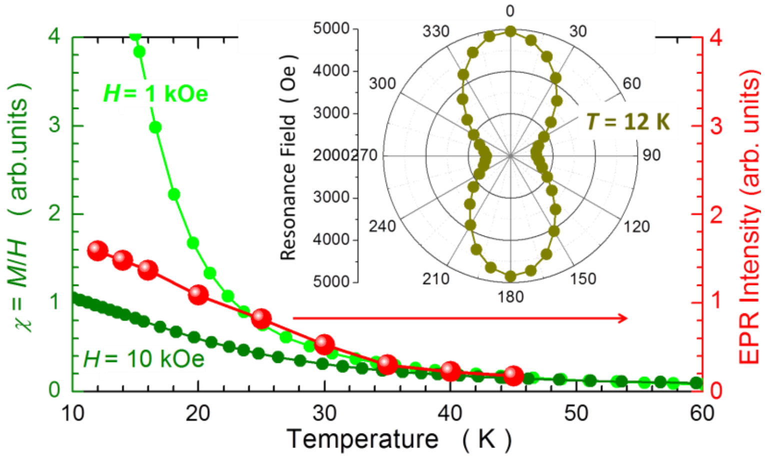

Fig.1 Comparison of magnetic susceptibilities determined by SQUID at fields of 1 and 10 kOe with that determined from FMR signal intensity at fields about 2 kOe. The inset shows the angular dependence of the resonance fields at 12 K

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