Temperature dependence of magnetic resonance in ferrimagnetic GdFeCo alloys

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Antiferromagnetic spintronics has been gaining much attention in both fundamental and practical points of view [1,2]. Antiferromagnetically-coupled ferrimagnets have recently been emerging as useful material platforms for studying antiferromagnetic dynamics since we can use conventional techniques for ferromagnets to investigate them. Both field-driven [3] and current-driven [4,5] domain-wall dynamics in ferrimagnets are found to be fastest at the angular momentum compensation temperature T_A, indicating that the magnetic dynamics becomes antiferromagnetic-like. In the context of the antiferromagnetic-like dynamics, however, the ferrimagnetic resonance (FiMR) has not been fully clarified. In this presentation, we revisit the FiMR in ferrimangetic GdFeCo compounds theoretically and experimentally, and show the rigorous analysis for the FiMR.

For this study, we used a 5-nm SiN/10-nm $Gd_{25.0}Fe_{65.6}Co_{9.4}$/5-nm Pt/100-nm SiN/Si substrate. We measured spin-torque induced FiMR spectra at several temperatures T between 220 K and 295 K by using the homodyne technique. It is found that the spectral linewidth of the resonance peak strongly depends on T. From those FiMR spectra, we calculate the two versions of the effective Gilbert damping parameter: α_{FM} based on the conventional expressions of ferromagnetic resonance [6] and α_{FiM} based on our theory for FiMR that accounts for the difference between the net spin density and the saturated total spin density in ferrimagnets. As shown in Fig. 1, α_{FM} increases significantly as T approaches T_A, in good agreement with Ref. [6], while $\alpha_{\mathrm{FiM}}(\approx 0.01)$ is insensitive to T in sharp contrast to α_{FM}. This indicates that the T dependence of the spectral linewidth in FiMR is attributed to the T dependence of the net spin density instead of that of α_{FM}. Our results provide a clear evidence that properly defined Gilbert damping parameter α_{FiM} of ferrimagnets is insensitive to T, which is consistent with some recent reports [7,8].

Reference

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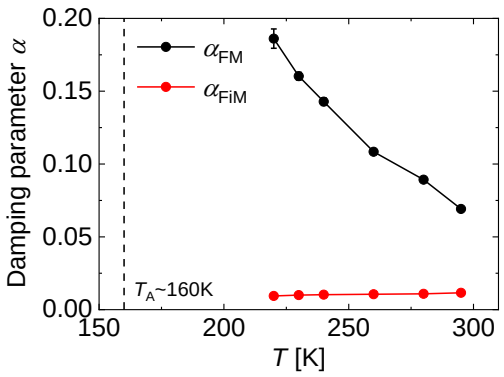

Fig.1 The effective Gilbert damping parameter α_{FM} and the properly defined Gilbert damping parameter α_{FiM} as functions of temperature.