STABILIZATION OF THE ANTIFERROMAGNETIC CONFIGURATION IN IN-PLANE MAGNETIZED SYNTHETIC ANTIFERROMAGNETS

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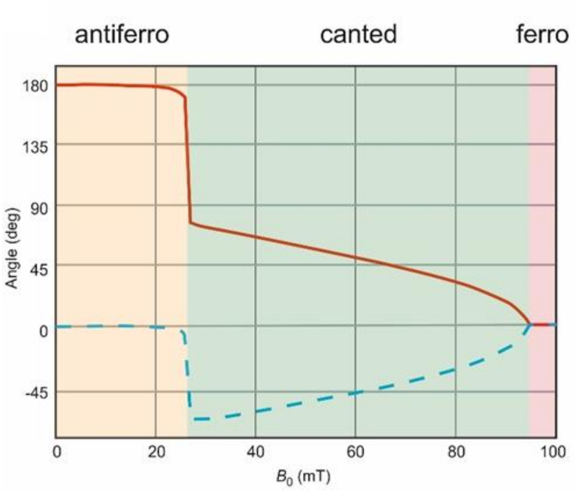
Synthetic antiferromagnets (SAFs) [1] are magnetic nanostructures composed of two or more ferromagnetic layers coupled antiferromagnetically. Depending on the applied magnetic field, a SAF can be switched between three magnetic configurations: antiferromagnetic (AF), canted (C), and ferromagnetic (FM) (Fig. 1). In in-plane magnetized SAFs, the AF configuration can be stabilized at finite magnetic fields due to in-plane uniaxial anisotropy [1]. A similar effect can also be achieved through shape anisotropy in SAF waveguides formed by two flat ferromagnetic strips.

We consider SAF waveguides to be promising candidates for magnonic applications. Compared with conventional bilayer SAFs, they offer several important advantages: (i) enhanced static and dynamic dipolar coupling, which complements the standard Ruderman-Kittel-Kasuya-Yosida (RKKY) interaction mediated by a spacer layer such as Ru; (ii) stabilization of the AF-configuration at finite bias fields; (iii) multimode spin-wave propagation in two distinct channels, namely acoustic and optical modes [2]; and (iv) nonreciprocal spin-wave transmission in the C-configuration [3], which is more easily controlled.

In this poster, we move toward a systematic study of SAF waveguides by investigating magnetization switching and the stabilization of the AF-configuration in an SAF bilayer with in-plane uniaxial anisotropy. We will present results for a CoFeB bilayer coupled by RKKY interaction, taking into account the effects of external magnetic field, static strain, and geometry. Static strain modifies the effective magnetic anisotropy through magnetoelastic coupling. First, the results reported in [4] were reproduced using numerical simulations performed with MuMax+. The analysis was then extended to examine the influence of bilayer width (i.e. SAF waveguide) and variations of the external control parameters (field, strain).



The switching process between the magnetic states can be characterized by two critical fields: the spin-flop field, $H_{SF} = 25.5\ \mathrm{mT}$, corresponding to the AF → C transition and an abrupt reorientation of the magnetizations, and the saturation field, $H_{sat} = 97\ \mathrm{mT}$ marking the C → FM transition and the parallel alignment of both magnetizations.

Fig. 1 Stabilized magnetic state of CoFeB bilayer coupled by RKKY interaction. As applied magnetic field increases, orientation between magnetization of layers shifts. This plot is an accurate reconstruction of results obtained in [4].

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