T08

Effect of Spin Transfer Torque through Ru in Synthetic Antiferromagnet

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Giant magnetoresistance (GMR) and spin-transfer torque (STT) are two sides of one coin. For instance, $\triangle R \cdot \triangle I$ is constant [1] where $\triangle R$ ($\triangle I$) is the difference in resistance (switching current) between anti-parallel magnetic state and parallel one. Synthetic antiferromagnet (SyAF) is being used as a pinned layer in magnetic read heads or memories to minimize dipolar stray fields. It is composed of two ferromagnets (FMs) that are antiferromagnetically coupled across a thin Ru spacer. Recently, several groups have studied current-induced magnetic excitations of SyAF [2, 3]. In interpreting the experimental results, spin-transfer through Ru was ignored because GMR through Ru is generally much smaller than that through a typical spacer such as Cu. In the same sample of FM1|Cu|FM2|Ru|FM3, however, NIST group [2] reported a sizable GMR through Ru which is about 67% of GMR through Cu. The relatively large GMR indicates a sizable STT through Ru. In this work, by extending the drift-diffusion model [4] for any multilayered stack, we study the current-induced magnetic excitation of SyAF in the above mentioned structure with and without considering spin-transfer through Ru. Because of three FMs, STT is described by two angles, $\Theta 1$ and $\Theta 2$ where $\Theta 1$ ($\Theta 2$) is the angle between FM1 (FM3) and FM2 (Fig. 1). It was found that the spin-transfer through Ru significantly affects STTs at three interfaces; Cu|FM2, FM2|Ru, and Ru|FM3. In the presentation, effects of the spin-transfer through Ru on the current-induced magnetic excitations of SyAF (especially acoustic and optical mode) will be discussed.

Reference

[1] S. Urazhdin et al., Appl. Phys. Lett. 84, 1516 (2004).
[2] A. M. Deac et al., Intermag2008, CB-03.
[3] D. Gusakova et al., Intermag2008, CB-04.

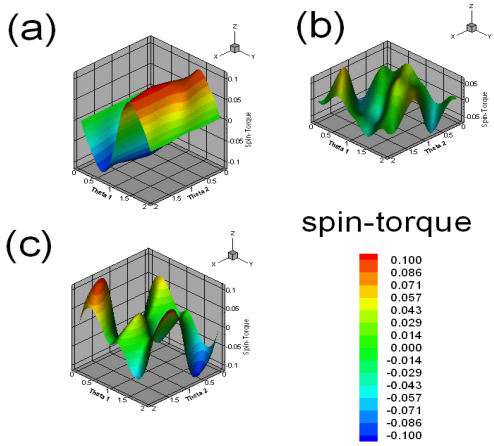

Fig. 1. Spin-torque as a function of $\Theta 1$ and $\Theta 2$ at interface of (a) Cu|FM2, (b) FM2|Ru, and (c) Ru|FM3.