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Enhanced anti-damping torque in double-Spin-Hall trilayers

SATORU EMORI, TIANXIANG NAN, CARL BOONE, TREVOR OXHOLM, DAVID BUDIL, Northeastern University, JOHN JONES, BRANDON HOWE, GAIL BROWN, Air Force Research Laboratory, NIAN SUN, Northeastern University — In magnetic thin-film heterostructures, current-induced anti-damping torque can switch magnetization [1], drive domain walls [2], and induce precessional dynamics [3]. The spin Hall effect in ferromagnet/normal-metal bilayers is an especially promising mechanism for generating a robust anti-damping torque. We report on enhanced tuning of resonant magnetization dynamics in in-plane magnetized Ta/CoFeB/Pt trilayers, where both the Ta and Pt layers serve as spin-Hall sources. The change in resonant linewidth induced by in-plane DC current is measured using spin-torque ferromagnetic resonance (FMR) [4] and cavity-based FMR [5]. With optimized Ta and Pt layer thicknesses, we observe in 4-nm thick CoFeB a damping modification of $> 3 \times 10^{-3}$ per 10^{11} A/m^2 of DC current, effectively more than doubling the anti-damping torque compared to conventional spin-Hall bilayers. This finding presents a new possibility for increasing the efficiency of spin-Hall driven devices.

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[3] V. E. Demidov et al. Nat. Mater. 11, 1028 (2012).
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