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Extraction of spin-transport parameters from ferromagnetic resonance measurements of spin-pumping in metallic multilayers
CARL BOONE, HANS NEMBACH, JUSTIN SHAW, THOMAS SILVA, National Institute of Standards and Technology — We use ferromagnetic resonance to measure damping due to spin-pumping in symmetric multilayers of Ta(3)/Ni(x)/Pd(y)/CoFe(2)/Pd(y)/Ni(x)/Ta(3) (thicknesses in nm, $0 \leq x \leq 2$nm, $0 \leq y \leq 10$nm). The stack's symmetry ensures that spin-pumping on both sides of the ferromagnet is identical and allows us to unambiguously characterize the multilayer spin-transport properties. When x = 0 (no Ni), the Pd-Ta interface is found to be strongly spin-impedant, due to the low spin conductivity of Ta, leading to greatly reduced damping for thin Pd. As the Pd thickness approaches the spin diffusion length, the damping increases. By inserting Ni, a strong spin absorber, at the Pd/Ta interface, the damping for thin Pd is maximized. Varying the thickness of the Ni layer can be used to tune the inter-layer spin current flow in the Pd/Ni/Ta heterostructure. Comparison of the data with the conventional model for diffusive spin-polarized transport in normal metals permits quantitative determination of the spin-diffusion length in the normal metals. The results have implications for the detection of spin-currents in lateral spin valves via the inverse spin Hall effect in high-resistivity materials such as Ta.

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