Nonlinear Giant Magnetoresistance in permalloy dual spin valves: spin transfer torque and band structure effects

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9.7 cm

The recent discovery of nonlinear current-dependent magnetoresistance in dual spin valve devices opens up the possibility for novel physics which extends the standard model of giant magnetoresistance. When the outer ferromagnetic layers of a dual spin valve are anti-parallel, the resulting accumulation of spin in the middle ferromagnetic layer (composed of permalloy) strongly modifies its bulk and interfacial spin asymmetry and resistance. Here, we examine the role of bulk spin accumulation in this nonlinear effect and show that interfacial spin accumulation alone cannot account for the observed dependence of the effect on the thickness of the middle ferromagnetic layer. We also report how the spin transfer torque acting on the middle ferromagnetic layer is modified by the nonlinear effect and can be used to better understand certain dynamical features associated with this effect. Finally, we show that varying the middle permalloy layer composition results in a significant change in the magnitude of the effect and its subsequent sign reversal with dc bias. The magnitude and sign reversal of the effect with dc bias current can be explained by modification of the gradient of the density of states at Fermi energy resulting from a change in permalloy composition.

13.4 cm

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