Ultrafast Spin Transfer Torque Generated by a Femtosecond Laser Pulse

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In transition metals and their alloys, featuring spin polarized 3d valence band and conduction 4s band, a laser pulse can excite electrons from the d band into the s one with higher electron mobility. The nonequilibrium hot charge carriers migrate away from the laser spot and reduce the local magnetic moment as described by the superdiffusive spin transport model [1], which takes into account scattering of hot electrons on atomic sites leading to nonequilibrium avalanches of excited electrons. Here, we theoretically study the spin transfer torque and magnetization dynamics induced by femtosecond laser pulse in a spin valve consisting of two magnetic layer with perpendicular magnetizations separated by a nonmagnet. To this end, we have developed a four-channel model of spin transport, which allows us to calculate spin transfer torque and describe magnetization dynamics.

References:

[1] M. Battiato, K. Carva, P. Oppeneer Phys. Rev. Lett. 105, 027203 (2010); Phys. Rev. B 86, 024404 (2012).