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New mechanism of spin transfer torque and anisotropic magnetoresistance in a ferromagnetic metal with a spin-orbit coupled interface[1]

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In a ferromagnetic metal layer (FML) with a spin-orbit-coupled interface, an in-plane electrical current can cause a perpendicular spin current injection from the interface and hence gives rise to spin transfer torque (STT) on the magnetization. The effect originates from spin rotation during electron scattering at the interface. We derive an analytical expression for the induced spin current and show that it is proportional to the strength of the interfacial spin orbit coupling (SOC) and to the spin polarization of the FML. Furthermore, the spin current is found to decay rapidly (over spin dephasing length) near the interface, leading to a STT that has both in-plane and out-of-plane components. We emphasize that our mechanism is completely based on the scattering of electrons in bulk Bloch states rather than on the properties of spin-orbit coupled surface states[1-4]. Another interesting consequence of the interfacial SOC is an anomalous anisotropic magnetoresistance. As long as the resistivity of the FML is spin dependent, the interfacial SOC will mix the two current channels, leading to an increase in resistivity even when the interface is perfectly flat. Moreover, the resulting AMR exhibits an unconventional angular dependence.

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