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Theory of spin Hall magnetoresistance (SMR) and related phenomena[1]

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A new anisotropic magnetoresistance effect has recently been found for a Pt film on top of the insulating ferrimagnet Yttrium-Iron-Garnet (YIG) [1-6]. We interpret this effect by the simultaneous action of spin Hall and inverse spin Hall effects as a non-equilibrium proximity phenomenon dubbed spin Hall magnetoresistance (SMR). This mechanism does not require the equilibrium proximity magnetization in Pt, which was assumed in [5]. We computed the SMR in F|N and F|N|F layered systems, where F is a magnetic insulator, treating the normal metal N by spin-diffusion theory with quantum mechanical boundary conditions at the interfaces in terms of the spin-mixing conductance [7]. Our results explain the experimentally observed spin Hall magnetoresistance in F|N bilayers. An analysis of the Hall effect when magnetization is normal to the plane allowed the experimental observation of the imaginary part of the mixing conductance [4]. For F|N|F spin valves we predict enhanced SMR amplitudes when magnetizations are collinear. In this talk I review the state of the art and discuss recent extensions of the SMR theory.

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