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Phase diagram and optimal switching induced by spin Hall effect[1]

SHU YAN, YA. B. BAZALIY, Department of Physics and Astronomy, University of South Carolina — In a ferromagnet/heavy-metal bilayer device with strong spin Hall effect, an in-plane current excites magnetic dynamics through spin-torque transfer. We analyze bilayers with a perpendicularly magnetized ferromagnet and calculate three-dimensional phase diagrams describing switching due to application of external magnetic field at a fixed current. For fields applied in the plane formed by the film normal vector and the current direction, we find the location of the additional equilibria created by the spin torque and give analytic expressions for two different destabilization boundaries. We further discuss the nature of switching at each boundary and qualitatively describe the magnetic state evolution. By analyzing the phase portraits of the system we give the condition at which switching from "up" to "down" state proceeds through this intermediate state. Using numeric simulations we analyze the switching time and compare it to that of a spin valve with a perpendicular polarizer.

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