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Spin-transfer torque driven de-pinning of a domain-wall in a magnetic nano-wire LUC THOMAS, MASAMITSU HAYASHI, XIN JIANG, RAI MORIYA, CHARLES RETTNER, STUART PARKIN, IBM Almaden Research Center — We present a theoretical study of the dynamics of a magnetic domain wall trapped in a potential well, driven by current-induced spin-transfer torque, in the presence of an external magnetic field. We show the existence of two regimes and two different mechanisms for the de-pinning of the domain wall using a one dimensional model. This model reveals that in small magnetic fields the critical current for de-pinning of the domain wall is completely independent of the pinning potential and weakly dependent on the magnetic field. Whereas, above some critical field, the critical current density is sensitive to the pinning potential and, moreover, strongly decreases with increasing field. Analytical expressions of the field dependence of the critical de-pinning current are derived for each regime, in the zero damping limit. The influence of adiabatic and non-adiabatic spin-transfer torques is also discussed. These theoretical predictions are compared to experimental results and to micromagnetic simulations.

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