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Current-induced domain wall motion in ferromagnetic semiconductors[1]

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Low magnetization (∼0.05 T) and high spin-polarization in ferromagnetism of transition metal-doped GaAs allow us to explore a number of spin-dependent phenomena not readily accessible in metal ferromagnets. Spin-polarized current induced domain wall (DW) motion in (Ga,Mn)As [1, 2] reveals rich physics resulting from the interaction between spin-polarized electrons and localized spins inside a magnetic DW. By using a 30 nm thick (Ga,Mn)As layer (x_{Mn} = 0.045) with perpendicular magnetic anisotropy, we have measured by magneto-optical Kerr microscopy a wide range of velocity-current density curves in the sample temperature range of 97 – 107 K. Two regimes are found in the current density dependence of the DW velocity. At high-current densities ($>$ 2 x 10^5 A/cm^2), the domain wall velocity is approximately a linear function of the current density above a threshold current density. This result will be compared to the recent theories of DW motion. At low-current densities, the functional form of the velocity-current curves follow an empirical scaling law, obtained by modifying the one for magnetic-field induced creep. This shows that current-induced DW creep is present. We have also determined the intrinsic resistance of the DW in a similar configuration [3].

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3. D. Chiba, M. Yamanouchi, F. Matsukura, T. Dietl, and H. Ohno, Phys. Rev. Lett. **96**, 096602 (2006).

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