# Universality Classes of Domain Wall Creep Motion in (Ga,Mn)As

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Spin-polarized current induced domain wall (DW) motion reveals rich physics resulting from the interaction between spin-polarized conduction electrons and localized spins in a DW. By using a 30 nm thick, 5 mm wide (Ga,Mn)As stripe ($x_{Mn}$ = 0.045) having perpendicular magnetic anisotropy, we determined the DW velocity ($\upsilon$) versus current density ($j$) curves with the sample temperature as a parameter using magneto-optical Kerr microscopy. Two regimes in the $\upsilon$-$j$ characteristics are shown to exist. At high-current densities (> 2 x $10^5$ A/cm$^2$),the domain wall velocity was a linear function of the current density above a threshold [1, 2]. At low-current densities, the functional form of the velocity-current curves turned out to be more complex, following a non-trivial empirical scaling lawsimilar to the one observed previously in the magnetic-field driven creep motion in magnetic metals. The former regime is well described by spin-transfer theories, indicating that spin-transfer from the spin-polarized conduction carriers to the localized spins was taking place. Examination of the latter regime and comparison with the magnetic-field driven creep measured on the same (Ga,Mn)As sample has revealed that both follow similar scaling laws but with different scaling exponents, indicating that the two drives, the spin-current drive and the magnetic-field drive, act on DW in fundamentally different waysbelonging to two different universality classes.

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References

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