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Kinetic and Static Domain-wall Pinning at Notches on Ferromagnetic Nanowires

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We investigate the domain wall (DW) pinning and depinning processes at notches of ferromagnetic nanowires by means of micromagnetic calculation. Two distinct pinning mechanisms are examined— the kinetic pinning for a moving DW to be trapped at a notch and the static depinning for a trapped DW to move from the notch. Interestingly, the kinetic pinning field is revealed to be noticeably smaller than the static depinning field. The DW energy landscapes around the notch visualize that the kinetic DW motion bypasses the lowest energy state, from which the static depinning field is determined. This phenomenon is basically equivalent to the kinetic and static friction processes in classical mechanics.

Index Terms-Ferromagnetic nanowire, Domain wall, Notch, Pinning, Permalloy

ET02

Capacitance Enhanced Synchronization of Pairs of Spin-transfer Oscillators

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The spin torque oscillator (STO) is a spintronic device capable of microwave generation at frequencies in the 1 - 40 GHz range with quality factors as high as 18000 [1]. However, the very limited power output has to be improved through, e.g., synchronization of two or more STOs. Synchronization of serially connected STOs has been suggested, where the STOs are connected in series with a dc current and then in parallel connection with a resistive load [2].

In this work, we proposed a new circuit consisting of two STOs as shown in Fig. 1 Fig. 2 shows the simulated synchronization phase diagram as a function of I_{dc} and anisotropy field difference for different capacitance - C (without this capacitor, synchronization only persist to about 4% of ΔH_k). The robustness against H_k variations improves when we increase the coupling capacitance from 0.01 pF to 0.06 pF (Fig. 2 a and b) and tops out at C = 0.06 pF (Fig.2b). Beyond 0.06 pF, the synchronized region again shrinks and there is no more benefit from a further increase in C (see Fig. 2d).

In summary, we found that the synchronization of the STOs is much enhanced by tuning the capacitance in the system, and the severe demands on limited STO variability are thus reduced by almost two orders of magnitude.

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