TITLE: Non-adiabatic spin torque investigated using thermally activated magnetic domain wall dynamics

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ABSTRACT BODY: The detailed understanding of the influence of spin-polarized currents on the local magnetization as well as the determination of the corresponding spin torque terms is of scientific interest and essential for many proposed applications. While the influence of thermal effects on the controlled domain wall motion has been neglected or considered as detrimental in the past, we present an approach using thermal fluctuations for the investigation of the non-adiabatic spin torque.
Thermally activated transverse and vortex domain walls jumping between two pinning sites in permalloy wires are investigated by transmission electron microscopy. The motion occurs at room temperature and is of pure thermal origin without the influence of external fields or electron currents. Since the distributions of the dwell times that the domain walls stay at each of the two pinning sites obey the Arrhenius law, this domain wall movement can be described by a 1D quasi-particle image of the domain wall moving in a potential with two metastable states which are separated by an effective energy barrier. The contribution from spin-polarized constant currents to this pinning potential is calculated analytically and the result is compared to numerical simulations. By transmission electron microscopy the change of the pinning potential is investigated for constant current densities which are far below the threshold values needed for controlled DW propagation and do not induce significant heating in the permalloy wires. We derive the non-adiabatic coefficient for a transverse (0.010+/-0.004) and for a vortex (0.073+/-0.026) domain wall where the difference between these values is attributed to the non-adiabatic transport resulting from high magnetization gradients present at the region of the vortex core [1]. The comparatively large value for the vortex domain wall is promising for applications requiring high domain wall velocities for fast switching processes.

References: [1] M. Eltschka et al., Phys. Rev. Lett. (in press 2010).

KEYWORDS: non-adiabatic spin torque, thermal activation.