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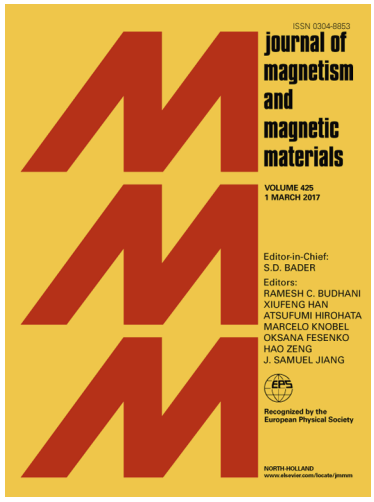

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Non-equilibrium dynamic reversal of in-plane ferromagnetic elliptical disk

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The ultrafast switching mechanism of an in-plane magnetized elliptical magnetic disk by applying a dynamic out-of-plane magnetic field pulses is investigated by performing micromagnetic simulations. For the in-plane magnetized nanostructures, the out-of-plane magnetic field is able to rotate the direction of magnetization when the precession torque overcomes the shape anisotropy of the system. This type magnetization reversal is one of non-equilibrium dynamic within a certain transition time util the precession torque is equivalent to the damping torque. By controlling the rise time or fall times of dynamic out-of-plane field pulses, the transition time can be also successively tuned and then an ultrafast switching of an elliptical magnetic nano-disk is clearly achieved by controlling the precessional torque. As another reversal approach, sinusoidal magnetic fields in gigahertz range are applied to the system. Consequently, the thresholds of switching fields are drastically decreased. We also reveal that the ferromagnetic resonance frequencies at the center and the edge of the elliptical disk are most important for microwave sinusoidal out-of-plane magnetic field induced magnetization reversal.

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