Experiment-based thermal micromagnetic simulations of the magnetization reversal for ns-range clocked nanomagnetic logic

Abstract:
Extensive thermal micromagnetic simulations, based on experimental data and parameters, were performed to investigate the magnetization reversal in Co/Pt nanomagnets with locally reduced perpendicular anisotropy on the nanosecond range. The simulations were supported by experimental data gained on manufactured Co/Pt nanomagnets, as used in nanomagnetic logic. It is known that magnetization reversal is governed by two mechanisms. At pulse lengths longer than 100 ns, thermal activation dominates the magnetization reversal processes and follows the common accepted Arrhenius law. For pulse lengths shorter than 100 ns, the dynamic reversal dominates. With the help of thermal micro-magnetic simulations we found out that the point where the both mechanisms meet is determined by the damping constant $\alpha$ of the multilayer film stack. The optimization of ferromagnetic multilayer film stacks enables higher clocking rates with lower power consumption and, therefore, further improve the performance of pNML.

Stichworte:
Magnets, magnetization reversals, active noise control, focused ion beam technology, magnetic anisotropy

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