Theoretical comparison of magnetization switching characteristics for spin-polarized current assisted recording, precessional switching and toggle switching of magnetization in soft magnetic materials

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The present paradigm of magnetic data storage is approaching its fundamental limits for areal storage density, as well as for speed in data processing. As a result, several magnetic recording alternatives, such as spin polarized current assisted recording, toggle switching, and precessional switching, are currently under intense research focus [1, 2]. The above mentioned techniques are characterized by sub-Stoner-Wohlfarth (SW) switching threshold [3-6] and sub-nanosecond switching times. This presentation is aimed at providing a theoretical comparison of the main switching characteristics for these recording techniques, emphasizing their performances with respect to minimum switching magnetic field, magnetization reversal time, and power efficiency. The analysis is performed under the framework of Landau-Lifshitz type equations for describing the magnetization dynamics, with its various forms depending on the recording technique under consideration. The comparison combines recently derived analytical expressions for the switching characteristics [3-6] with novel analytical results for several symmetric designs, while the general analysis is undertaken by numerical means. In the figure, analytical critical field curves for SW switching, precessional switching and spin-polarized current assisted reversal are presented.

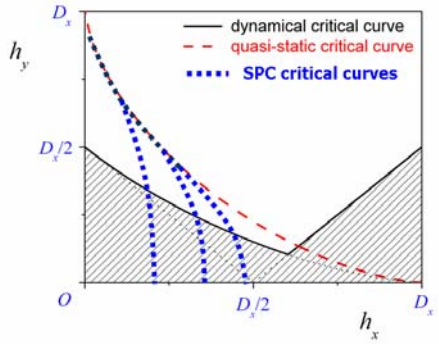

Figure 1: Analytical critical curves for SW switching, precessional switching and spin polarized current assisted switching (for three values of the spin torque intensity)

[1] G. Bertotti and I. Mayergoyz (eds.), Science of Hysteresis, Elsevier (2006).

[2] B. Hillebrands and A. Thiaville (eds.), Spin dynamics in confined magnetic structures III, Springer (2006)

[3] M. Dimian, A. Gindulescu, C. Acholo, Adv. Elec. Comp. Eng. **9** (2009) 3

[4] I. Mayergoyz, M. Dimian, G. Bertotti, C. Serpico, J. Appl. Phys. **97** (2005) 10E509

[5] D.C. Worledge, IBM J. Res. & Dev. **50** (2006) 69

[6] H. Fujiwara, S.-Y. Wang, M. Sun, J. Appl. Phys. **97** (2005) 10P507

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