Current-driven Domain Wall Dynamics in Cylindrical Nanowires with Modulated Diameter

A. De Riz[1*], J.-C. Toussaint[2], Ch. Thirion[2], O. Fruchart[1], D. Gusakova[1]

[1] Univ. Grenoble Alpes, CNRS, CEA, Grenoble INP, INAC-SPINTEC, Grenoble, France
[2] Univ. Grenoble Alpes, CNRS, Institut NEEL, Grenoble, France

*arnaud.deriz@cea.fr

Ordered arrays of cylindrical nanowires fabricated by template-assisted electroplating techniques are promising for the development of a three-dimensional memory. In such memory, the information would be carried by magnetic domains separated by domain walls (DWs) which are driven by spin-polarized current pulses via a spin-transfer effect. The control of the DWs position could be obtained by creating localized diameter modulations which act as pinning sites. In order to optimize the DWs propagation through the modulations, it is essential to understand the influence of the geometry on the magnetization vector field behavior. Numerical modeling is a powerful tool for this task. Here we consider a transverse DW inside a cylindrical nanowire presenting a smooth modulation in diameter [1]. We performed micromagnetic simulations using our finite elements based software FeeLLGood which solves the Landau-Lifshitz-Gilbert equation augmented with current-driven effects [2]. We develop a simple analytical model which allows us to calculate the domain wall position and thus to extract a scaling law for the domain wall pinning conditions as a function of geometrical parameters.

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[2] M.Sturma, J.-C. Toussaint, D. Gusakova, J. Appl. Phys. **117**, 243901 (2015).