Spin-transfer-torques-induced domain-wall motion in ferromagnetic Pt/Co/Pt nanowires with perpendicular magnetic anisotropy

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The spin-current-based electric controllability of ferromagnetic domain walls (DWs) has been of great interest because of its feasible applications such as next-generation memory and logic devices. In particular, nanowires with perpendicular magnetic anisotropy have been predicted as more suitable materials for practical applications [1]. However, the experimental verification with multiple DWs control in such materials has not been explored yet. And also, the physical driving mechanism resulting from the competition between the spin transfer torques (STTs)—adiabatic STT and nonadiabatic STT—and disorders is still controversial. By using Pt/Co/Pt nanowires which exhibit weak and homogeneous microstructural disorders, here we experimentally demonstrate that the purely current driven multiple DWs motion can be obtained at current densities less than 10^7 A/cm2, allowing random magnetic bits recording and transferring without severe temperature rising [2]. Furthermore, based on the DWs motion driven by magnetic field and/or current, we can unambiguously distinguish the role of STTs on thermally activated magnetic domain wall motion [3,4]. The adiabatic STT—resulting in quadratic contribution to effective field—is found to be dominant for large current densities, whereas the nonadiabatic STT—playing the same role as magnetic field—subsisted at low current densities. This finding will provide a step to the complete understanding of STT induced DW dynamics as well as the technological progress in DW based emerging nanodevices.

1. K.-J. Kim *et al.*, *Nature* **458**, 740 (2009).
2. K.-J. Kim *et al.*, *Appl. Phys. Express* **3**, 083001 (2010).
3. J.-C. Lee *et al.*, *Phys. Rev. Lett.* **107**, 067201 (2011).
4. K.-J. Kim *et al.*, *Phys. Rev. Lett.* **47**, 217205 (2011).