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Motion of Magnetic Bubbles by Electric Currents in Perpendicular Anisotropy Films

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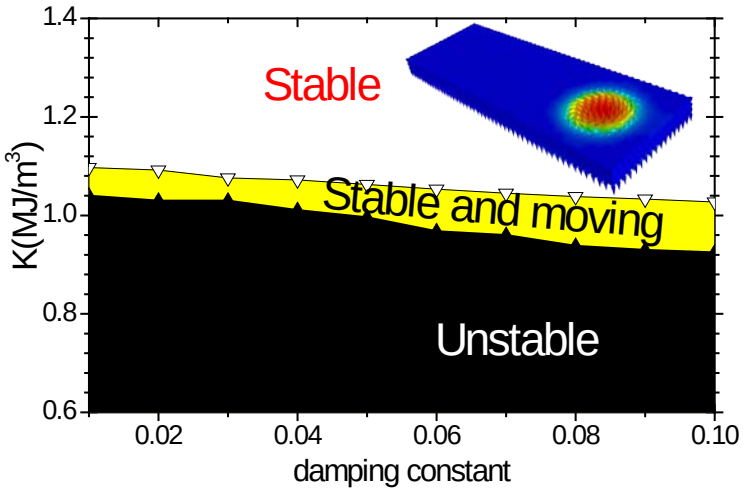
Recently “topologically protected” spin textures as Skyrmions have attracted a lot of interest for future spintronic devices [i] due to their unique properties as stability, rapid and defect-insensitive current-driven motion [ii]. Here we present a micromagnetic study of the stability and current-driven motion of Skyrmions in elongated thin film structures (180nm x 60nm x10nm) which technically simulate magnetic wires as the demagnetization factors along the three directions do not differ substantially from the □ x 60nm x10nm case. The stabilization is done solely by perpendicular anisotropy i.e. without any Dzyaloshinskii–Moriya underlayers. The initial Skyrmion configuration rapidly relaxes to a bubble formation which under the presence of a current of 10^8A/cm^2 can move with velocities from 32 m/s for damping constant α=0.01, to 62 m/s for α=0.09. It is found that there is only a narrow range of magnetocrystalline anisotropy values (which depend weakly on the α) that permit the stabilization and current driven motion of Skyrmion-like structures along the wire.



[i] Xichao Zhang, Motohiko Ezawa and Yan Zhou, Nature Scientific Reports 5 (2015) 9400
[ii] J. Sampaio, V. Cros, S. Rohart, A. Thiaville And A. Fert Nature Nanotechnology 8 (2013) 839