Spin accumulation, spin currents, and torque, in the problem of motion of a sharp domain wall in magnetic nanowires

V. R. Vieira[a], P. D. Sacramento[a], V. K. Dugaev[a,b], and J. Barnaś[c]

[a]CFIF and Departamento de Física, Instituto Superior Técnico, Lisbon, Portugal
[b]Frantsevitch Institute for Materials Science, NASU, Chernovtsy, Ukraine
[c]Department of Physics, Adam Mickiewicz University, Poznań, and
Institute of Molecular Physics, PAS, Poznań, Poland

We consider the motion of a sharp domain wall in magnetic nanowires with electric current. The width of the domain wall is much smaller than the electron wavelength, which is typical for magnetic semiconductors. We calculate the distributions of the spin density and the spin current related to different modes of the scattering states. The accumulated transverse components of the spin density and the spin current oscillate in the vicinity of the wall and they essentially affect its dynamics whereas the longitudinal part of the spin current is responsible for another component of the spin torque creating a force for the current-induced motion of the domain wall along the nanowire.
We also analyze the dynamics of the sharp domain wall using the standard Landau-Lifshits-Gilbert formalism and the two-component spin torque calculated for this model. We demonstrate that the domain wall changes its shape depending on the velocity of the motion, and we calculate this velocity as a function of the electric current.

9.7 cm

13.4 cm

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Corresponding author :
Vitor Vieira

Address for correspondence :
CFIF, Instituto Superior Técnico, Av. Rovisco Pais, 1049-001 Lisbon, Portugal

Email address :
vrv@cfif.ist.utl.pt