Strain-mediated motion of magnetic domain walls in transversely isotropic hexagonal magnetostrictive materials with Rashba effect and dry-friction dissipation

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In this work, we report an analytical investigation to characterize the motion of magnetic domain walls along the major axis of a thin magnetostrictive layer tightly glued to the upper surface of a thick piezoelectric actuator. We consider a transversely isotropic hexagonal subclass of magnetostrictive materials that exhibit structural inversion asymmetry. We perform the analytical investigation under the one-dimensional extended Landau-Lifshitz-Gilbert equations, which delineate magnetization dynamics driven by the magnetic fields and spinpolarized electric currents in the simultaneous presence of magnetoelastic, magnetocrystalline anisotropy, Rashba fields, and nonlinear *dry-friction* dissipation. By employing the standard traveling wave ansatz, we derived the analytical expressions of the most relevant dynamical entities (domain wall velocity, mobility, threshold, breakdown, and propagation direction) that describe the domain wall motion in the steady and precessional dynamic regimes. Our investigation reveals how effectively the considered parameters can control the domain wall motion. Finally, numerical illustrations of the obtained analytical results show a qualitative agreement with the experimental reports.

References

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