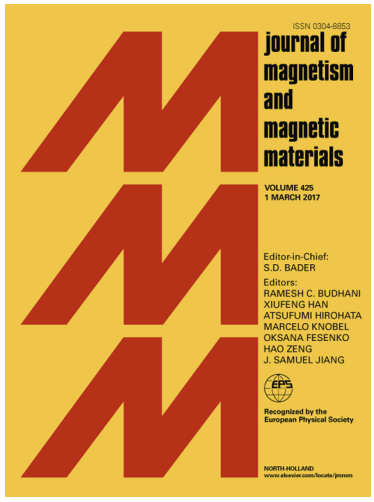

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Propagation of electromagnetic soliton in a spin polarized current driven weak ferromagnetic nanowire

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Abstract

We investigate the nonlinear spin dynamics of a spin polarized current driven anisotropic ferromagnetic nanowire with Dzyaloshinskii-Moriya interaction (DMI) under the influence of electromagnetic wave (EMW) propagating along the axis of the nanowire. The magnetization dynamics and electromagnetic wave propagation in the ferromagnetic nanowire with weak anti-symmetric interaction is governed by a coupled vector Landau-Lifshitz-Gilbert and Maxwell's equations. These coupled nonlinear vector equations are re-casted into the extended derivative nonlinear Schrödinger (EDNLS) equation in the framework of reductive perturbation method. As it is well known, the modulational instability is a precursor for the emergence of localized envelope structures of various kinds, we compute the instability criteria for the weak ferromagnetic nanowire through linear stability analysis. Further, we invoke the homogeneous balance method to construct kink and anti-solitonic like electromagnetic (EM) soliton profiles for the EDNLS equation. We also explore the appreciable effect of the anti-symmetric weak interaction on the magnetization components of the propagating EM soliton. We find that the combination of spin-polarized current and the anti-symmetric DMI have a profound effect on the propagating EMW in a weak ferromagnetic nanowire. Thus, the anti-symmetric DMI in a spin polarized current driven ferromagnetic nanowire supports the lossless propagation of EM solitons, which may

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