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Supercritical propagation of nonlinear magnetization wave through an antiferromagnetic magnonic crystal

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Analytical model of a nonlinear magnetization wave (MW) propagating through one-dimensional antiferromagnetic magnonic crystal comprised of two sorts of antiferromagnets (AFM) is proposed for supercritical mode when the MW velocity exceeds the critical velocity of MW in both antiferromagnets AFMs or at least in one of them. Both AFMs that comprise the magnonic crystal are assumed to be two-sublattice uniaxial ones. The Landau-Lifshitz equations have been used in the sigma model with account for the exchange bias between magnetic sublat-tices of both AFMs, the magnetic anisotropy, the magnetic dipole-dipole interaction and the Dzyaloshynskii-Moriya interaction. The boundary conditions for the Néel vector (with the exchange bias between magnetic sublattices of both AFMs taken into account) are applied on the interface between two AFMs. The discrete sets of frequencies and velocities for the considered MW are obtained. Analysis of the results shows that the nonlinear MW is reflection-less, phase-coherent and possesses a number of parameters that can be considered as degrees of freedom for encod-ing information. These findings open up new possibilities of digital data processing utilizing nonlinear MW propa-gating through antiferromagnetic magnonic crystal in supercritical mode.

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