DUAL TUNABLE THIN-FILM MAGNONIC CRYSTAL BASED ON A WIDTH MODULATED SLOT-LINE

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Nowadays an increased interest to the theoretical and experimental investigations of the artificial periodic waveguiding structures is evident. Magnonic crystals (MCs) are magnetic materials with a spatial periodic modulation of their physical properties or geometry. For example, many papers were devoted to investigation of spin waves (SWs) in one or two dimensional MCs (see e.g. [1-3] and literature therein). Artificial periodicity of the magnetic film structures results in emergency of band-gaps in the spin-wave spectrum and modifies the dispersion of the SWs in the vicinity of the band-gaps. Therefore, MCs are promising for practical application such as phase shifters [4], spin-wave logic gates [5], magnetic field sensors [6], microwave oscillators [7], and other.

The purpose of the present work is theoretical investigation of the thin-film periodic ferrite-ferroelectric structures based on a slot transmission line. Such MCs combine advantages of thin-film planar topology and dual tunability. The amplitude-frequency characteristics of the thin-film multiferroic magnonic crystals were calculated by the transfer-matrix method. Influence of different geometrical parameters on the frequency response and band-gap positions was analyzed.

It was found that investigated structure can provide good signal rejection of more than 30 dB. The optimum rejection efficiency and the required band-gap bandwidth can be obtained by adjustment of the MC geometry. An application of bias voltage of 200 V to thin ferroelectric film leads to the shift of the band-gaps on 8.35 MHz. At the same time, the change of the external magnetic field by 10 Oe shifts the band-gaps on 29.9 MHz. Therefore, proposed structures looks favorable for development of new microwave devices and investigation of new physical phenomena. This work was supported in part by Academy of Finland.

[1] A. V. Chumak et. al. Nature Physics. 11(6), 453-461 (2015).
[2] V. V. Kruglyak et. al. J. Phys. D: Appl. Phys. 43, 264001 (2010).
[3] M. Krawczyk and D. Grundler, J. Phys.: Condens. Matter. 26, 123202 (2014).
[4] Y. Zhu, K. H. Chi, C. S. Tsai, Applied Physics Letters. 105 (2), 022411 (2014).
[5] A.A. Nikitin et.al., Applied Physics Letters, 106(10), 102405 (2015).
[6] M. Inoue et al. Applied Physics Letters. 98 (13). 132511 (2011).
[7] E. Bankowski, et. al. Applied Physics Letters, 107(12), 122409 (2015).