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Sub-harmonic excitation in passive spintronic diodes under simultaneous action of voltage-controlled magnetic anisotropy and spin-transfer torque

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Spin-torque diodes based on magnetic tunnel junctions (MTJs) are nanoscale devices having a wide range of potential industrial and technological applications. In addition to spin-transfer torque (STT) and tunnel magnetoresistance, MTJ allows to efficiently exploit surface and interface phenomena to manipulate the ferromagnetic state and excite resonant modes in the device. The effect of voltage controlled magnetic anisotropy (VCMA) is of a particular interest as being one of the most efficient for magnetization manipulation [1].

In this work, by means of micromagnetic simulations we predict a fractional parametric resonant response in passive spintronic diode excited simultaneously by STT and VCMA. Importantly, fractional resonances are quite strong and only a few times smaller than the main linear resonance. Developed analytical theory reveals, that the observed resonances are forced higher-order parametric resonances, which occur under simultaneous action of parametric pumping (provided by VCMA) and linear excitation force (STT). These forced resonances are observed at the frequencies f_0/n, n = 2,3,4,… (f_0 is the linear resonance frequency), in contrast to spontaneous higher-order parametric resonances, which can occur more often, at frequencies $2f_0/n$ [2].

The studied resonance mechanism can enhance frequency band of spintronic detectors, as well as can be useful for frequency multiplication and compact demodulation schemes.

Reference list

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