A micromagnetic study of the parametric resonance response driven by voltage-controlled magnetic anisotropy

Anna Giordano[1], Andrea Grimaldi[2], Eleonora Raimondo[2], Riccardo Tomasello[3], Mario Carpentieri[3], Giovanni Finocchio[2]

[1] *Department of Engineering, University of Messina, Messina, I-98166, Italy*
[2]*Department of Mathematical and Computer Sciences, Physical Sciences and Earth Sciences, University of Messina, Messina, I-98166, Italy*
[3]*Department of Electrical and Information Engineering, Polytechnic of Bari, Bari, I-70125, Italy*

Spintronic diodes (STDs) exhibit potential advantages over semiconductor. They are compact (nanoscale size), CMOS-compatible, energy-efficient [1][2]. In particular, the STDs allows to use many driving forces to tune their rectification response, such as the voltage controlled magnetic anisotropy (VCMA) [3]. Here, we have predicted a fractional parametric resonance response driven by the simultaneous excitation of VCMA and ac spin-transfer torque for spintronic diodes working in the passive regime.

This resonance is characterized by the ferromagnetic resonant frequency, the standard parametric excitation at twice the resonance frequency and several other sub-harmonic peaks, all of which are an integer fraction (1/2, 1/3, etc.) of the main resonance frequency. We have performed a systematic study of the resonance response of the MTJ as a function of VCMA amplitude. The dynamics is driven by the presence of VCMA and simultaneity by spin-transfer-torque driven by an ac in-plane spin-polarized current density (*Jac =0.1MA/cm*^{2}), and both current density and VCMA have the same frequency.

The figure 1 shows the results that are obtained by considering the current value fixed and varying only the value of VCMA (KVCMA =0, 50, 100 mT). In absence of VCMA, we obtained a frequency resonance of 4.88GHz. With adding of VCMA, not only the same frequency, we obtained other frequencies minor, until to 7 for the value of VCMA higher and in this case is present also an peak at twice the ferromagnetic frequency (labelled -1). This work opens a new direction for the use of spintronic diodes in the field of communication, as a single device would have the ability to detect more information carriers.

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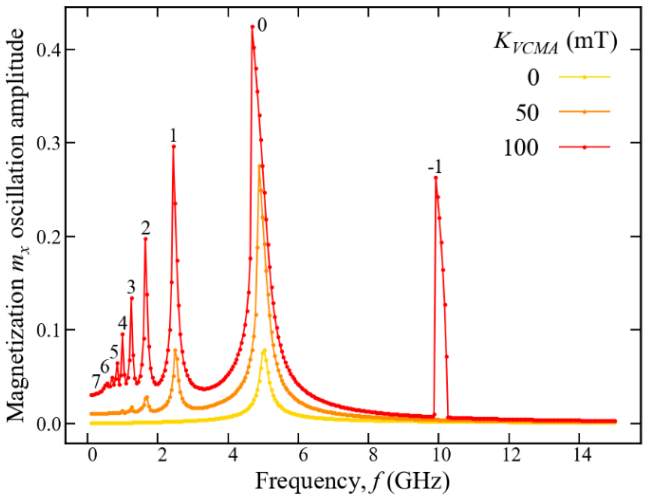

Figure 1: Oscillation amplitude of the x-component of the magnetization mx as a function of the frequency of the ac current density Jac with different values of the VCMA coefficient $KVCMA$.

References

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