

Nanoscale physics

Microwave frequency detector based on array of nano-scale spin-torque microwave detectors

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The spin-torque microwave detectors (STMD) employing a magnetic tunnel junction (MTJ) can be used for the detection of an external microwave signal [1]. In typical experiments [2] STMD works as a frequency-selective quadratic detector with a resonance signal frequency is close to the ferromagnetic resonance frequency of the free layer (FL) of an MTJ.

In this work we propose a novel type of spintronic microwave frequency detector based on an array of two uncoupled nano-scale STJ that might be used for the accurate determination of an external microwave signal frequency even for the signals of unknown microwave power. We find the equation for the frequency of an external microwave signal acting on the array STMDs as a function of detector's parameters and measured output dc voltages. We show the frequency determination error substantially decreases in the frequency range between STJ resonance frequencies and may become 2–5 times smaller than the linewidth of a single STMD. This effect manifests itself more clearly for detectors having a smaller thickness of the FL. Obtained results can be useful for the development and optimization of microwave frequency detectors with low frequency determination errors and other microwave devices based on STMD arrays.

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1. Prokopenko O.V., Krivorotov I.N., Meitzler T.J., Bankowski E., Tiberkevich V.S., Slavin A.N. Spin-Torque Microwave Detectors // In book: Magnonics: From Fundamentals to Applications. Topics in Applied Physics (Vol. 125) / Ed. S.O. Demokritov and A.N. Slavin. – Berlin: Springer-Verlag, 2013. – P. 143-161.
2. A.A. Tulapurkar, Y. Suzuki, A. Fukushima, H. Kubota, H. Maehara, K. Tsunekawa, D.D. Djayaprawira, N. Watanabe & S. Yuasa Spin torque diode effect in magnetic tunnel junctions // Nature.-2005.-**438**, N 7066. -P. 339-342.