Spin torque antiferromagnetic nanooscillator in the presence of noise

O. Gomonay and V. Loktev

Bogolyubov Institute for Theoretical Physics National Academy of Sciences of Ukraine, Metrologichna str. 14-b, 03680, Kyiv, Ukraine
E–mail: malyshen@ukrpack.net

Spin-torque effects in antiferromagnetic (AFM) materials are of great interest because of the possible applications as high-speed spintronic devices, including nanostructured ones. It was recently shown [**?**] that the characteristic frequency of AFM-based nanooscillator controlled by the spin-polarised dc current can fall into the range from 0.1÷ 1 THz. In this presentation we analyse the statistical properties of such an oscillator that result from the influence of delta-correlated Gaussian noise of the magnetic nature (analogous equations for ferromagnet, FM, see in [**?**]. Based on the Lagrange equations for magnetic dynamics of the collinear AFM we derive corresponding Fokker-Plank equation and find the stationary distribution over the oscillator energy in both subcritical (current value J is below the precession threshold, $J < J_{\rm cr}$) and overcritical ($J > J_{\rm cr}$) regimes. We show that in the subcritical regime spin-polarised current suppresses energy fluctuations of AFM ocsillations, energy dispersion being proportional to $J_{\rm cr} - J$, like FM nanooscillator [**?**]. In the overcritical regime the energy fluctuations are proportional to the temperature and are current-independent, while the average energy grows with the current value. Thus, in contrast to FM materials, the quality factor of the AFM-based nanooscillator should increase with the current (in neglection of heating effects). So, antiferromagnets have certain preferences as the active spintronic components compared with the traditionally used FM materials.

References

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