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Nonlinear Theory of Microwave Generation by Spin-Polarized Current[1] ANDREI SLAVIN, Department of Physics, Oakland University, Rochester, Michigan 48309, PAVEL KABOS, Electromagnetics Division, National Institute of Standards, Boulder, Colorado 80305 — An approximate analytic theory of microwave spin wave generation by spin-polarized direct current in magnetic nano-contacts magnetized in an arbitrary direction is developed. For sufficiently large density of spin-polarized current the damping in the magnetic "free" layer is compensated and a quasi-uniform precession of magnetization about the direction of the *internal* bias magnetic field $\mathbf{H}$ (which differs from the direction of the *external* bias field $\mathbf{H}_e$ applied to the "free" layer) is excited. The precession amplitude is subsequently limited by the positive nonlinear dissipation of the same precession. With the increase of the current magnitude $I$the angle of precession increases, making precession *nonlinear*, and *reducing the projection* M_z of the precessing magnetization vector on the axis of precession (z-axis). This reduction of M_z is responsible for the observed frequency shifts of the generated microwave oscillations and for the limitation of their amplitudes. Due to the influence of demagnetizing fields in the "free" layer the nonlinear frequency shifts have different magnitudes and signs for different orientations of the external bias field $\mathbf{H}_e$. The theory gives good qualitative and even partly quantitative explanation of the majority of recent experimental results on microwave generation by direct current in nano-contacts.

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