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Current spin-orbit-induced microwave spin dynamics in magnetic nanostructures

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The intercoupling between a spin current and magnetic order in magnetic nanostructures underlies of the current-induced manipulation by magnetic dynamics and vice-versa, the magnetic-induced manipulation by the spin current [1-3]. The spin current can be converted from an input current under the internal effective magnetic fields of interactions of different origin (including *s-d* exchange and spin-orbit interactions) with corresponding features of the spin torque exerting on the magnetic order, specifically, a magnetic order oscillation. The frequency of the latter is determined by the exchange interaction in magnetic material [1, 2]. The prospect of obtaining the technological magnetic nanostructures with low threshold input currents, low power consumption and high frequencies of the controlled magnetic dynamics is related to the spin-orbit generated spin current and utilizing active magnetic with strong antiferromagnetic interaction.

The current spin-orbit-controlled microwave oscillation is realized in magnetic nanostructures composed of a heavy metal nanolayer (as Pt, Ta) with strong spin-orbit interaction and the adjacent active magnetic with antiferromagnetic exchange interaction (based on ferri- or antiferromagnetic interactions). The conversion of incoming current within heavy metal into the spin current occurs as results of the spin Hall (SH) effect of deflection of electrons with different spin polarizations in opposite directions. In the Landau-Lifshitz-Gilbert-Slonczewski dynamic model for magnetic sublattices allowing for the feed-back from the combined effect of the SH and its reverse process that connects the spin pumping with spin backflow, conditions of a steady-state spin torque oscillations which can achieve tens THz.

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