Exchange Magnon in Ferromagnetic Thin Films Exited by a Series of Acoustic Pulses

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Ultrafast demagnetization and precession of the magnetization induced by ultrashort laser pulses are very active topics[1-4] even though their demonstration is quite recent[5]. The idea of data transmission by using the spins rather than electric currents had a large impact. Ultrafast manipulation of the magnetization is a key for further development of spintronics. Magnetization dynamics can be driven by different mechanisms[6]. Since we consider a single ferromagnetic, we can limit our consideration just to two mechanisms: laser-induced heating[2,6] and phonon-magnon interaction[7].

Here, we report a numerical study of the magnetization dynamics in nickel thin films (30 nm) excited by a series of picosecond acoustic pulses. This situation can be realized in an optical pump-probe experiment using a train of laser pump pulses. Absorption of each pump pulse leads to the excitation of an acoustic pulse. Acoustic pulses propagate through a ferromagnetic film and alter the direction of the effective magnetic field thereby driving precessional motion of the magnetization. The direction of the effective magnetic field can also be modified by laser-induced thermal effects. We consider only the phonon-magnon interaction.

We study the impact of the acoustic pulses on the magnetization precession, varying the time delays between the pulses, the shapes of the pulses. We study different coupling conditions: phase matching, group matching and frequency matching.

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