Observation of two-step laser-induced demagnetization process in Ni-Mn-Sn Heusler alloy film

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The ultrafast magnetization dynamic processes are investigated in a broad timescale range for different laser pump fluences in Ni- and Mn-rich Heusler alloy film of $Ni_{54.3}Mn_{31.9}Sn_{13.8}$ composition using time-resolved magneto-optical Kerr effect (TR-MOKE) in perpendicular magnetic field geometry. For all fluences used, two distinct types of magnetization dynamics of different timescales: ultrafast up to 2 picoseconds (range I) and slower from 2 ps to hundreds of ps (range II), were observed. The description of the two-step de- and remagnetization processes were performed on the basis of microscopic three-temperature model (M3TM) [1] in the frame of extended eM3TM model [2]. In transition from I to II timescale range, the model parameters: electron-lattice coupling g_{el} and demagnetization rate R decreases over two order of magnitude but weakly depend on the fluence. The calculated spin-flip probability a_{sf} decreases over one order of magnitude as well. The reasons for demagnetization slowing down effect observed in the Ni-Mn-Sn film in range II are related with lowering of the exchange interaction and Curie temperature proximity [2]. The model parameters g_{el}, R and a_{sf} in range I are of the same order as in Ni metal and can be explained through the electron-phonon-mediated spin-flip scattering processes [1].

References:

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