Magnetization reversal and domain structures of ultrathin iron garnet films

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The possibility of nonthermal magnetization reversal using ultrashort light and strain pulses has triggered search of novel materials at nanoscale. Here, we report on the magnetic properties of ultrathin Tb-doped iron garnet films with a thickness of 100 nm. To investigate the magnetic domain structures and magnetization dynamics, we employed wide-field magneto-optical microscopy and time-resolved magneto-optical spectroscopy in the Faraday geometry. We find labyrinthine domains with different period under an applied magnetic field at room temperature. The time-resolved measurements were performed as a function of external magnetic field, state of pump polarization, and pump wavelength in the near-infrared and mid-infrared ranges using ultrashort laser pulses. The roles of intrinsic dynamic, magnetic and optical properties in the processes of ultrafast laser-induced magnetization dynamics and magnetization reversal have been studied. Our results show the polarization-dependent, optically induced magnetoelastic anisotropy in a garnet film. Moreover, we demonstrate magnetization switching at magnetic domains driven by longitudinal optical phonons using mid-infrared laser pulses. These results can be identify a pathway for laser-driven control of magnetization reversal based on the modification of magnetoelastic anisotropy in ultrathin garnet films.

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