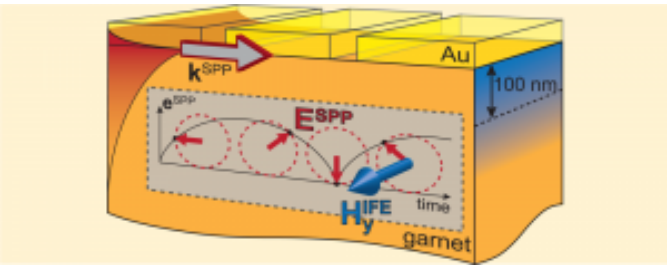
Surface Plasmon-Mediated Nanoscale Localization of Laser-Driven sub-Terahertz Spin Dynamics in Magnetic Dielectrics

We report spatial localization of the effective magnetic field generated via the inverse Faraday effect employing surface plasmon polaritons (SPPs) at Au/garnet interface. Analyzing both numerically and analytically the electric field of the SPPs at this interface, we corroborate our study with a proof-of-concept experiment showing efficient SPPdriven excitation of coherent spin precession with 0.41 THz frequency. We argue that the subdiffractional confinement of the SPP electric field enables strong spatial localization of the SPP-mediated excitation of spin dynamics. We demonstrate two orders of magnitude enhancement of the excitation efficiency at the surface plasmon resonance within a 100 nm layer of a dielectric garnet. Our findings broaden the horizons of ultrafast spin-plasmonics and open pathways toward nonthermal optomagnetic recording on the nanoscale.



KEYWORDS: Ultrafast spin dynamics, surface plasmon−polariton, inverse Faraday effect, rare-earth iron garnet, nonlinear optics, Magnetoplasmonics

Effective static magnetic field induced by a propagating SPP at the Au/magnetic garnet interface.

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