

Magnetization rotation-based polarization control of spintronic terahertz emitter

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ABSTRACT

Recently, the terahertz family of sources increased by newly-developed terahertz spintronic emitter (STE), which competes with the traditional in many ways. This 30THz-broadband gapless source is versatile due to its low-cost, easy implementation, frequency-independent excitation, and perpendicularly-given polarization to the STE's magnetization. Nowadays, the polarization control of STEs was demonstrated by rotating and multipolar magnets, a twisted magnetic field, or cascades of STEs. The methods suffer from mechanical stability, realization difficulties, and limited polarization control. We introduce here our new approach to control the emitted polarization following Stoner–Wohlfarth magnetization rotation within our FeCo/TbCo₂/FeCo-based STE exploiting magnetic anisotropy. The varying magnetic field along the hard magnetic axis induces the magnetization rotation, performing the polarization control. We present full-360-degree linear polarization control, not needing mechanically rotating components. This technique guarantees higher stability for polarimetry applications. We prove the whole terahertz spectrum follows the polarization control, preserving even the phase of sub-picosecond terahertz emission. It offers easy polarization calibration of the emitter for terahertz experimental setups. Moreover, we provide models to explain magnetic hysteresis defining the polarization behaviour. We predict that the polarization-controlled STEs will find many applications covering terahertz time-domain polarimetry and ellipsometry, medical imaging and security detection.

Keywords: terahertz spintronic emitter, polarization control, THz time-domain spectroscopy, terahertz photonics, polarimetry, ellipsometry, magnetic anisotropy, rare-earth materials

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