Antenna-coupled spintronic terahertz emitters driven by a 1550 nm femtosecond laser oscillator

We demonstrate antenna-coupled spintronic terahertz (THz) emitters excited by 1550 nm, 90 fs laser pulses. Antennas are employed to optimize THz outcoupling and frequency coverage of ferromagnetic/nonmagnetic metallic spintronic structures. We directly compare the antenna-coupled devices to those without antennas. Using a 200 lm H-dipole antenna and an ErAs:InGaAs photoconductive receiver, we obtain a 2.42-fold larger THz peak-peak signal, a bandwidth of 4.5 THz, and an increase in the peak dynamic range (DNR) from 53 dB to 65 dB. A 25 lm slotline antenna offered 5 dB larger peak DNR and a bandwidth of 5 THz. For all measurements, we use a comparatively low laser power of 45mW from a commercial fiber-coupled system that is frequently employed in table-top THz time-domain systems.

Schematic of THz emission from photoexcited FMANM bilayers, plain and microstructured. (a) A femtosecond laser pulse triggers ultrafast spin transport from the FM into the NM layer where the spin current js flowing along the z axis is converted into a charge current jc along the y direction, acting as a source of THz radiation. The direction of the in-plane magnetization of the FM layer is set along the x axis by an external magnetic field Bext. (b) Current distribution in an unstructured (plain) bilayer and (c) the STE bilayer embedded in the gap of an antenna. Note that THz current generation by the ISHE is independent of emitter type and antenna choice