Spin and charge current dynamics in spintronic THz emitters

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ABSTRACT

Ultrafast spin-to-charge conversion in heterostructures composed of ferromagnetic (FM)/non-magnetic (NM) thin films can give rise to the emission of THz electromagnetic waves [1]. The experimental scheme involves the use of femtosecond (fs) laser pulses to trigger ultrafast spin and charge dynamics in FM/NM bilayers, where the NM layer features a strong spin-orbit coupling. Via the inverse spin Hall effect (ISHE), the spin current generated in the FM layer by the fs-laser pulse is converted to an ultrashort charge current burst that gives rise to the THz radiation [1].

In this presentation, I will show the potential of spintronic THz emitters (STE) for stronger THz radiation and adjustable bandwidth by studying the spin and the subsequent charge current dynamics after the laser illumination.

I will initially focus on the FM/NM interface engineering and its correlation to the strength of the excited spin current which is the source of the THz radiation [2]. Next, I will discuss that not only the spin current dynamics but also the charge redistribution is important for the properties of the THz signal [3]. The charge relaxation leads to a current backflow with a delay and a time constant that mainly depends on the conductivity and the dielectric properties of the emitter.

References