Terahertz emission from ultrafast spin-charge current at a Rashba interface

Qi Zhang, Matthias Benjamin Jungfleisch, Argonne Natl Lab, Wei Zhang, Oakland University, John E. Pearson, Haidan Wen, Axel Hoffmann, Argonne Natl Lab — Ultrafast broadband terahertz (THz) radiation is highly desired in various fields from fundamental research in condensed matter physics to bio-chemical detection. Conventional ultrafast THz sources rely on either nonlinear optical effects or ultrafast charge currents in semiconductors. Recently, however, it was realized that ultrabroad-band THz radiation can be produced highly effectively by novel spintronics-based emitters that also make use of the electron’s spin degree of freedom \(^1\). Those THz-emitters convert a spin current flow into a terahertz electromagnetic pulse via the inverse spin-Hall effect. In contrast to this bulk conversion process, we demonstrate here that a femtosecond spin current pulse launched from a CoFeB layer can also generate terahertz transients efficiently at a two-dimensional Rashba interface between two non-magnetic materials, i.e., Ag/Bi. Those interfaces have been proven to be efficient means for spin- and charge current interconversion \(^2,^3\).

\(^1\) T. Kampfrath et al., Nat. Nanotechnol. 8, 256 (2013).

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