THz Emission Spectroscopy in Topological Insulators

Chih-Wei Luo and Chien-Ming Tu

Department of Electrophysics, National Chiao Tung University, Hsinchu, Taiwan

cwluo@mail.nctu.edu.tw

The exotic properties of topological surface states in topological insulators (TIs) attract much attention due to their potentials in the applications of spintronics. Moreover, the optical coupling of topological surface states can also play an important role in the emerging optospintronics devices. In this study, we show the THz radiation generated from TI single crystals by ultrafast optical pulse excitation [1]. We found that the polarity of THz radiation pulse affected by the doping type of TIs. The polarity-reversal cannot be explained by the photo-Dember effect, which is usually used to explain THz radiation from conventional narrow bandgap semiconductors [2]. These findings provide alternative approaches to understanding the characteristics of TIs. Recently, we further studied the helicity-dependent THz emissions, originating from the helicity-dependent photocurrents, in topological insulator Sb_2Te_3 thin films by ultrafast optical excitation [3]. The polarity of the emitted THz radiation is controlled by both the incident angle and the helicity of ultrafast optical pulses. Employing a decomposition-recombination procedure in time domain (time-domain decomposition-recombination), the individual contributions of circular photogalvanic effect, linear photogalvanic effect and photon drag effect are fully separated. These results provide not only new insights in the optical coupling of topological surface states but also open up new opportunities for applying helicity-dependent THz emission spectroscopic characterization of spintronics devices.

References

[1] C. W. Luo, et al., Advanced Optical Materials, 1, 804 (2013).

[2] C. M. Tu, et al., Scientific Reports, 5, 14128 (2015).

[3] C. M. Tu, et al., Physical Review B, 96, 195407 (2017).