Coherent terahertz electric field drive of Weyl semimetal $Co_2Sn_2S_2$

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The coherent electric field drive by photoelectric fields have been attracted in recent years [1,2]. However, it has been very difficult to observe photoelectric field-driven phenomena in solids because the electron scattering time of ordinary materials is very fast, on the order of 10 fs, and electron scattering disturbs the coherence between light and electrons. Therefore, we have attempted to observe photoelectric field driven phenomena in the THz frequency band (~1 ps) by using Weyl semimetals, which have relatively long electron scattering times (several hundred fs to several ps).

We have measured the excitation intensity dependence of the high power THz pump/THz reflection spectra in the ferromagnetic Wely semimetal $Co_3Sn_2S_2$ with a Weyl band of a few ten meV at 7 K. High power THz pulses were generated by Ti-sapphire laser (1.55 eV, 1 mJ, 1 kHz, 70 fs) in a $LiNO_3$ crystal using the tilted wave front method. Figures 1 (a), (b), and (c) show the field intensity dependences of THz electric field waveform, the Fourier spectrum, and the intensity at 0.2 and 0.8 THz, independently. As shown in Fig. 1(b), a peak structure centered at 0.8 THz and a broad structure around 0.2 THz appeared, and the broad structure at 0.2 THz shows a nonlinear process proportional to the square of the excitation intensity as shown in Fig. 1(c). This indicates a DC current due to the coherent acceleration by the THz electric field and the non-adiabatic excitation process.

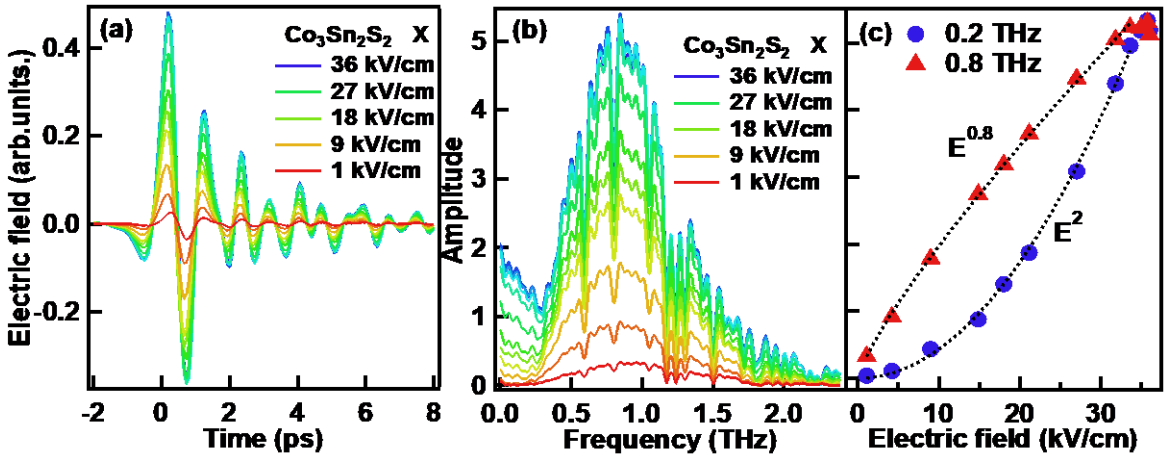

Figure 1. (a) the field intensity dependences of the time waveform of the THz electric field reflected from $Co_3Sn_2S_2$. (b) FFT spectrum of (a). (c) Excitation intensity dependence of the area value of the FFT spectrum.

[1] T. Higuchi, *et al.*, Nature **550**, 224–228 (2017).

[2] Y. Kawakami, *et al.*, Nat. Commun. **11**, 4138 (2020).