Ultrafast multi-THz photoconductivity in single crystal $CH_3NH_3PbI_3$

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Hybrid metal halide perovskites have taken the solar community by storm reaching peak power conversion efficiencies of 20.1% [1]. Investigations into the intrinsic photophysics of these materials, however, are still in the infancy stage and basic questions such as the exciton binding energy remain uncertain [2]. In this work, we outline time-resolved multi-THz measurements on single crystal $CH_3NH_3PbI_3$ after band-edge photoexcitation by fs pulses at 1.56 eV, revealing intrinsic dynamics and energetics of exciton dissociation into free charge carriers on sub-picosecond time scales. We directly observe the creation of mobile charges proceeding via exciton dissociation on a 1 ps time scale governed by thermal ionization at room temperature. Mobile carrier generation efficiencies are consistent with an exciton binding energy of 50 meV. The ac conductivity of the material is well characterized by a simple Drude model, revealing band transport with remarkably high mobilities of 500 – 800 cm^2/Vs.

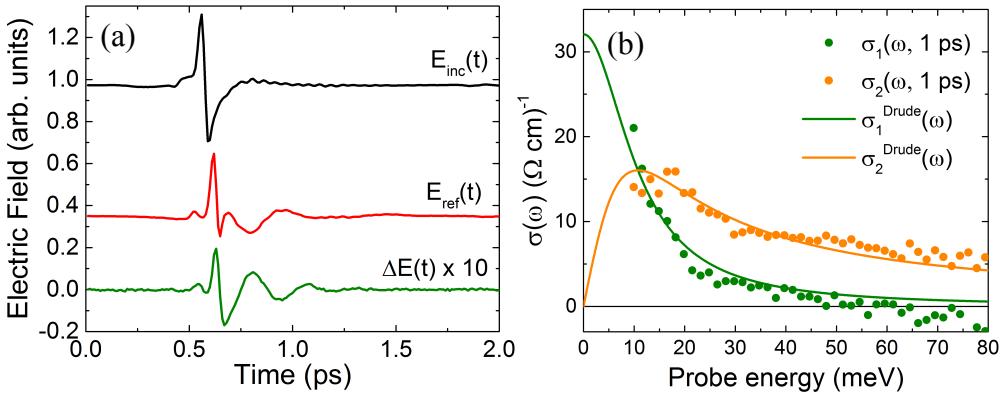

Fig. 1 (a) Time domain THz waveforms of incident, reflected and differential reflected pulse 1 ps after excitation. (b) Extracted ac conductivity at 1 ps after photoexcitation with Drude fits.

[1] H. Zhou et al., Science **345**, 542 (2014)
[2] Q. Lin et al., Nat. Photon. **9**, 106 (2015)
[3] D'Innocenzo et al., Nat. Comm. **5**, 1 (2014)