

Abstract

Project Code : MRG6080264

Project Title : The Investigation of Moisture-Induced Degradation of Organometallic Halide Perovskite Solar Cells

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Favorable transport and photo-physical properties are keys to the success of lead halide perovskites as photovoltaics materials. Phonons play an important role behind the two properties via the interaction with free carriers that eventually leads to the high solar conversion efficiency. A detailed description of carrier-phonon coupling is currently a challenge since the simultaneous detections of free-carrier relaxation and phonon dynamics are necessary. Here we satisfy the requirement by performing time-resolved terahertz spectroscopy at low temperature. We are able to detect a strong signatures of both carrier-phonon coupling and photo-generated free carriers, and subtract out the contribution from recombination dynamics in the background. The observations expose the intricate interplay between free carriers, excitons, and lowest-lying phonons, and reveal two important involvements of phonons in transport and photophysical properties of halide perovskites; phonon energies govern the number of possible scattering channels and determine the amount of carrier mobility; phonon emission creates an exciton that reduces the number of carriers but phonon absorption increases the number of carriers by breaking an exciton.

Keywords : Perovskite, degradation, terahertz spectroscopy, carrier lifetime