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In situ studies of transient photoconductivity in PbSe quantum dot solar cells JIANBO GAO, WEON-KYU KOH, NIKOLAY MAKAROV, JEFFREY PIETRYGA, VICTOR KLIMOV, Los Alamos Natl Lab — PbSe quantum dot (QD) solar cells have attracted significant interest due to their band gap tunability, easy-processing and flexibility. Efficiencies have risen from 1% just a few years ago to nearly 9% today. Furthermore, the novel concept of multiple exciton generation (MEG) resulting from quantum confinement makes these materials scientifically interesting counterparts to bulk semiconductors. Recent observations of more than 100% external quantum efficiency in PbSe QD solar cells confirm direct relevance of MEG to practical photovoltaics. However, in order to take full advantage of this effect, one needs a better understanding of photogeneration dynamics and carrier transport in QD solar cells. In this talk, we discuss a new technique for in situ measurements of transient photoconductivity with fast response time (<50 ps) applied to study carrier transport and photogeneration dynamics in PbSe QD solar cells. These measurements complement traditional photoconductivity techniques such as time-resolved microwave conductivity and time-of-flight. Based on the analysis of temperature, excitation wavelength and electrical field dependence measurements, we derive parameters such as MEG efficiency, carrier lifetime, trap-free mobility and carrier emission rate from trap states.

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