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Photovoltaic conversion via hot electron induced thermionic emission from quantum dots ANDREI SERGEEV, KIMBERLY SABLON, U.S. Army Research Laboratory, Adelphi, MD 20783, USA — Quantum dot (QD) nanomaterials provide numerous possibilities for nanoscale engineering of photoelectron processes for specific applications, such as lighting, sensing, and energy conversion. It has been found that QDs may increase the photovoltaic conversion efficiency due to enhanced coupling with electromagnetic radiation, multiple exciton generation, and two-step light absorption. The hot electron induced thermionic emission from QDs is a novel mechanism, which may be significantly enhanced due to optimization of QD parameters. In this two-step process the photoelectrons excited from the valence band to localized quantum dot states are extracted from QDs via thermionic emission, which may be initiated by thermal phonons, hot phonons, and hot electrons. Strong interaction between the localized quantum dot electrons and hot photoelectrons excited by high energy photons substantially increases the conversion efficiency due to use of energy of sub-bandgap photons and energy of hot photoelectrons, which otherwise would be lost in relaxation processes. Here we present the theoretical model of the conversion via thermionic emission from quantum dots, results of optimization of photoelectron processes, and experimental data, which evidence in favor of this mechanism.

Andrei Sergeev
U.S. Army Research Laboratory, Adelphi, MD 20783, USA

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