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Quantum-dot nanostructures for effective harvesting, detection, and conversion of IR radiation NIZAMI VAGIDOV, ANDREI SERGEEV, ANDREI ANTIPOV, Electrical Engineering Department, University at Buffalo, SUNY, KIMBERLY SABLON, JOHN LITTLE, U.S. Army Research Laboratory, Adelphi, VLADIMIR MITIN, Electrical Engineering Department, University at Buffalo, SUNY — Our novel approach to improve harvesting, detection, and conversion of IR radiation is based on engineering of three-dimensional potential barriers introduced by quantum dots with built-in charge due to inter-dot doping. The barriers around dots exponentially suppress capture processes and increase the photoelectron lifetime. The built-in-dot charge also strongly enhances the coupling of QD structures to IR radiation. Both effects radically improve the responsivity of IR photodetectors and photovoltaic efficiency of quantum-dot solar cells. Here we report a 50% increase in photovoltaic efficiency in quantum-dot solar cells as well as 25 times increase of the photoresponse of quantum-dot infrared photodetectors when the built-in-dot charge increases up to six electrons per dot. We also present results of modeling of photoelectron kinetics and discuss perspectives of IR photodetectors and solar cells based on quantum dots with built-in charge.

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