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Photoconductivity and free-carrier dynamics of silicon quantum dots MATTHEW BERGREN, Colorado School of Mines, PETER PALOMAKI, NATHAN NEALE, National Renewable Energy Laboratory, THOMAS FURTAK, Colorado School of Mines, MATTHEW BEARD, National Renewable Energy Laboratory — Silicon quantum dots (QDs) have recently been investigated for use in novel optoelectronic devices such as LEDs and PV. Plasma synthesized SiQDs offer very good control of SiQD size, crystallinity and size distribution. These dots have reported PLQYs >60%, making them excellent candidates for LEDs or biomarkers. In PV applications, charges need to be extracted from films, while for LEDs charges are injected into the film, and thus information about their electrical properties is desired. Time-resolved terahertz spectroscopy is uniquely suited to investigate photoinduced charge generation and transport in nanoscale systems in that it can measure the sample's photoconductivity with sub-ps resolution. In this study, we present the complex-frequency dependent photoconductivity of isolated SiQDs for a range of diameters. The ultrafast dynamics show a fast decay followed by a longer lifetime. We attribute the rapid decay to hot-carriers relaxing to bound excitons within the first ps after excitation for the isolated dots. A comparison is made between the isolated dots and thin films composed of the same material, illustrating the importance of QD-QD electronic coupling to achieve charge transport in these films.

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