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Phonon-assisted nonradiative energy transfer in quantum dot-silicon nanostructures PEDRO LUDWIG HERNANDEZ MARTINEZ, School of Electrical and Electronics Engineering, Nanyang Technological University, Department of Physics, Bilkent University, AYDAN YELTIK, Department of Physics, Bilkent University, BURAK GUZELTURK, Department of Electrical and Electronics Engineering, Bilkent University, ALEXANDER O. GOVOROV, Department of Physics and Astronomy, Ohio University, HILMI VOLKAN DEMIR, School of Electrical and Electronics Engineering, Nanyang Technological University, Department of Physics, Bilkent University — Silicon is one of the most dominant materials in photovoltaics and understanding the processes of energy transfer is of great importance. In this work, we study the phonon-assisted nonradiative energy transfer (NRET) in quantum dot (QD)-silicon hybrid nanostructures. Here, the NRET dynamics is investigated as a function of temperature for distinct separation thicknesses between the donor QDs and the acceptor silicon plane. We propose a theoretical model based on the phonon-assisted energy transfer process. We estimate the energy transfer rate using the Fermi's Golden rule where the matrix elements are derived for the phonon-assisted energy transfer process. To support our findings the temperature-dependent fluorescence lifetimes in QD-silicon nanostructures are analyzed. The experimental data analyses agree with the resulting theoretical model. The results indicate that phonons play an important role in NRET to Si as an indirect bandgap semiconductor.

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