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Efficient Exciton Transport Between Strongly Quantum-Confined Silicon Quantum Dots[1] MARK LUSK, ZHIBIN LIN, Deparment of Physics, Colorado School of Mines, ALBERTO FRANCESCHETTI, National Renewable Energy Laboratory — First-order perturbation theory and many-body Green function analysis are used to quantify the influence of size, surface reconstruction and surface treatment on exciton transport between small silicon quantum dots. Competing radiative processes are also considered in order to determine how exciton transport efficiency is influenced. The analysis shows that quantum confinement causes small ($\sim$ 1 nm) Si quantum dots to exhibit exciton transport efficiencies far exceeding that of their larger counterparts. We also find that surface reconstruction significantly influences the absorption cross-section and leads to a large reduction in both transport rate and efficiency. Exciton transport efficiency is higher for hydrogen-passivated dots as compared with those terminated with more electronegative ligands. This is because such ligands delocalize electron wave functions towards the surface and result in a lower dipole moment. This work [1] is a first step in the development of a framework for the design of quantum dot assemblies with improved exciton transfer efficiency.

[1] Z. Lin, A. Franceschetti and M. T. Lusk, arXiv:1110.6456v1 [cond-mat.mes-hall]

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