514f The Use of Heat Transfer Fluids in the Synthesis of High-Quality Cdse Quantum Dots, Core/Shell Quantum Dots, and Quantum Rods

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Fluorescent semiconductor nanoparticles, or quantum dots, have potential uses as an optical material, in which the optoelectronic properties can be tuned precisely by particle size. Advances in chemical synthesis have led to improvements in size and shape control, cost, and safety. A limiting step in large-scale production is identified to be the raw materials cost, in which a common synthesis solvent, octadecene, accounts for most of the materials cost in a batch of CdSe quantum dots. Thus, less expensive solvents are needed.

In this paper, we identify heat transfer fluids, a class of organic liquids commonly used in chemical process industries to transport heat between unit operations, as alternative solvents for quantum dot synthesis. We specifically show that two heat transfer fluids can be used successfully in the synthesis of CdSe quantum dots with uniform particle sizes. We show that the synthesis chemistry for CdSe/CdS core/shell quantum dots and CdSe quantum rods can also be performed in heat transfer fluids. With the aid of a population balance model, we interpret the effect of different HT fluids on QD growth kinetics in terms of solvent effects, i.e., solvent viscosity, CdSe bulk solubility in the solvent, and surface free energy.