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Photophysics of Strongly Confined Multiexcitons from the Perspective of Lasing and Solar Energy Conversion¹
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Using semiconductor nanocrystals one can produce extremely strong spatial confinement of electronic wave functions not accessible with other types of nanostructures. One consequence of this effect is a significant enhancement in carrier-carrier interactions that lead to a number of novel physical phenomena including ultrafast multiexciton decay due to Auger recombination and efficient generation of multiple electron-hole pairs by single photons via carrier multiplication. In this talk, I will discuss the implications of ultrafast Auger decay for lasing applications of the nanocrystals and describe several recent approaches developed in our group for resolving this problem by engineering carrier-carrier interactions in various types of heterostructured particles. I will also review the current status of carrier-multiplication research including experimental challenges in studies of this phenomenon, the role of extraneous effects, the competing energy relaxation channels, and applications of carrier multiplication in solar photovoltaics.

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