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"New" energy states lead to phonon-less optoelectronic properties in nanostructured silicon VIVEK SINGH, University of Colorado, YIXUAN YU, BRIAN KORGEL, University of Texas at Austin, PRASHANT NAGPAL, University of Colorado — Silicon is arguably one of the most important technological material for electronic applications. However, indirect bandgap of silicon semiconductor has prevented optoelectronic applications due to phonon assistance required for photon light absorption/emission. Here we show, that previously unexplored surface states in nanostructured silicon can couple with quantum-confined energy levels, leading to phonon-less exciton-recombination and photoluminescence. We demonstrate size dependence (2.4 - 8.3 nm) of this coupling observed in small uniform silicon nanocrystallites, or quantum-dots, by direct measurements of their electronic density of states and low temperature measurements. To enhance the optical absorption of the these silicon quantum-dots, we utilize generation of resonant surface plasmon polariton waves, which leads to several fold increase in observed spectrally-resolved photocurrent near the quantum-confined bandedge states. Therefore, these enhanced light emission and absorption enhancement can have important implications for applications of nanostructured silicon for optoelectronic applications in photovoltaics and LEDs.

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