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Nanoscale light emission: direct bandgap versus indirect bandgap[1] JUN-WEI LUO, SHU-SHEN LI, Institute of Semiconductors, Chinese Academy of Sci (CAS) — The electron-hole Coulomb interaction bounds an electron and a hole together forming an exciton and the e-h exchange interaction lifts the spin-allowed bright exciton state up with respect to the spin-forbidden dark state by an energy of 1 meV to tens meV depending on the NCs size. The recombination dynamics of the NC exciton remains open to debate, especially at high temperatures (T ¿ 20 K). One perception is a weak exchange interaction of dark excitons with the ensemble of dangling bonds on the NC surface, resulting in spin flip assisted recombination directly from the dark state. Another perception is thermal redistribution of excitons between the dark and bright states. By performing atomistic pseudopotential calculations of indirect bandgap Si NCs and direct bandgap InAs NCs in a large range of NC sizes, we found that the predicted recombination rates of NC excitons are in excellent agreement with experimental data provided by various groups. This agreement confirms the explanation of thermal activation of bright state of excition recombination dynamics in NCs. We also found that the exciton recombination rates, as function of confinement energy, of indirect bandgap NCs is distinct from direct bandgap NCs. More detail theoretical analyses will be presented.

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