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Auger electron-hole scattering leads to efficient $P \to S$ electronic relaxation in self-assembled (In,Ga)As/GaAs quantum dots[1] GUSTAVO A. NARVAEZ, Eclipse Energy Systems, Inc., St. Petersburg, Florida 33716, GABRIEL BESTER, ALEX ZUNGER, National Renewable Energy Laboratory, Golden, Colorado 80401 — We have applied our pseudopotential approach to predict Auger-type relaxation mechanisms in million-atom quantum dots. The electronic structure of (In,Ga)As/GaAs self-assembled quantum dots shows an excited P state about 30-50 meV above the lowest excited S state. Measured P-to-S relaxation times for electron-hole exciton range from 2-10 ps. Because the P-to-S energy spacing is comparable to the energy of an optical phonon, it has been argued that polaron relaxation is reponsible for the fast observed relaxation. Here, we show that in the presence of a hole, Auger electron-hole scattering—decay of the electron from P to S accompanied by an energy conserving hole excitation—leads to a fast, ps-scale decay without invoking polaron relaxation. To this end, we calculate the P-to-S decay lifetime $\tau(P \to S)$ of electrons in lens-shaped (In,Ga)As/GaAs dots due to Auger electron-hole scattering. We find that this Auger-type relaxation mechanism leads to $\tau(P \to S) \sim$ 1-7 ps for dots of different size, in agreement with available data.

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