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Cathodoluminescence study of thermal activation of carriers in InAs/GaAs(001) self-assembled quantum dots D. H. RICH, S. KHATSEVICH, O. MOSHE, Department of Physics, Ben-Gurion University of the Negev, P.O.B 653, Beer-Sheva 84105, Israel, E. KIM, A. MADHUKAR, Department of Materials Science, University of Southern California, Los Angeles, California 90089-0241 — We have examined state-filling and thermal activation of carriers in buried InAs/GaAs(001) self-assembled quantum dots (SAQDs) with excitation-dependent cathodoluminescence (CL) imaging and spectroscopy. The dependence of the CL intensity of the ground and various excited state transitions on excitation density was studied. The measurements reveal that carriers escape and are recaptured as excitons or correlated electron-hole pairs. At sufficiently high excitations, state filling and spatial smearing effects are observed together with a sublinear dependence of the CL intensity on excitation. Thermal quenching of the CL intensity of the QD ground and first excited state transitions at low excitations in ∼230 to 300 K temperature range is attributed to dissociation of excitons from the QD states into the InAs wetting layer. At high excitations, significantly lower activation energies of the ground and excited states are obtained, suggesting thermal reemission of single holes from QD states into the GaAs matrix is responsible for the observed temperature dependence of the QD luminescence in ∼230 to 300 K temperature range.

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