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Controlling the optical properties of self-assembled InAs/GaAs quantum dots by using multi-step rapid thermal annealing

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In the present work, self-assembled InAs quantum dots (QDs) on GaAs subjected to various annealing treatment were investigated by photoluminescence (PL). While the PL spectra of the quantum dot (QD) sample undergone by one-step annealing treatment within the range from 650 to 750 ℃ are blue-shifted with a little enhancement of PL intensity, the QDs subjected two- and three-step annealing procedures during increasing temperature showed significantly higher PL intensity with narrower linewidth, compared to those of one-step annealed QD sample. That is, since the QDs with one-step annealing process for 30 seconds at 750 ℃ show the full width at half maximum (FWHM) of 44 meV, the PL emissions of the QDs annealed at 650 and 750 ℃ through the multi-step rapid thermal annealing treatments are obtained with FWHM of 34 meV, which are about 0.75 times narrower than the those of one-step annealed QD sample, and also observed the stronger PL intensities. These results indicate that the structural and optical properties can be systematically manipulated and enhanced by multi-step annealing processes.