

Effect of Rapid Thermal Annealing on the Optical Properties of InAs Quantum Dots Grown on (100) and (311)B GaAs Substrates by Molecular Beam Epitaxy

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Abstract : The effect of rapid thermal annealing (RTA) on the optical properties of InAs quantum dots (QDs) grown at an As overpressure of 2×10^{-6} Torr by molecular beam epitaxy (MBE) on (100) and (311)B GaAs substrates was investigated using photoluminescence (PL) technique. PL results showed that for the as-grown samples, the QDs grown on the high index plane (311)B have lower PL intensity and lower full width at half maximum (FWHM) than those grown on the conventional (100) plane. The latter demonstrates that the (311)B QDs have better size uniformity than (100) QDs. Compared with as-grown samples, a blue-shift was observed for all samples with increasing annealing temperature from 600°C to 700°C. For (100) samples, a narrowing of the FWHM was observed with increasing annealing temperature from 600°C to 700°C. However, in (311)B samples, the FWHM showed a different behaviour; it slightly increased when the samples were annealed at 600°C and then decreased when the annealing temperature increased to 700°C. As expected, the PL peak intensity for all samples increased when the laser excitation power increased. The PL peak energy temperature dependence showed a strong redshift when the temperature was increased from 10 K to 120 K. The PL peak energy exhibited an abnormal S-shape behaviour as a function of temperature for all samples. Most samples exhibited a significant enhancement in their activation energies when annealed at 600°C and 700°C, suggesting that annealing annihilated defects created during sample growth.

Keywords : RTA, QDs, InAs, MBE

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