Four-wave mixing in InAlGaAs quantum dots

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have some intermediate separation. They cannot be very close together—due to level repulsion—and cannot be too far apart either—due to the finite linewidth.

References
bution of FWHM linewidths of about 60 lines, correct for the spectrometer response. This distribution of linewidths does not vary with energy across the quantum dot ensemble. The ensemble dephasing time measured in the FWM experiment corresponds to a homogeneous linewidth of 2\(\hbar T\) = 30 \(\mu\)eV, which agrees well with a typical single-dot PL linewidth.

We will also discuss the power and temperature dependence of the QD homogeneous linewidth as well as the dependence of detuning of the FWM signal with respect to the QD luminescence peak.


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Over 1.5-\(\mu\)m emissions at room temperature in InAs quantum dots In strained InGaAs quantum well

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Since it has been predicted that remarkable improvement of the threshold current density and temperature sensitivity will occur if quantum dots (QDs) are used as the active layer of semiconductor lasers, several groups have attempted to fabricate quantum dot lasers. Recently, it has been of great interest that QDs will be also available for band structure engineering of semiconductor lasers and many groups have achieved the room temperature lasing at 1.3-\(\mu\)m using QDs surrounded with strain-reducing layer as the active layer of laser structure. In this paper, we reported the over-1.5-\(\mu\)m luminescence at room temperature of InAs QDs in strained InGaAs quantum well (QW) grown by metalorganic chemical vapor deposition (MOCVD).

All samples were grown by low-pressure MOCVD using trimethylindium, trimethylaluminium, triethylgallium and tertiarybutylarsine. Firstly, we investigated the optical characteristics of InAs QDs capped by GaAs. InAs QDs were grown on (100) GaAs substrate. The V/III ratio during the growth of InAs QDs was approximately 30 and the growth rate was 0.011 ML/sec. The dot density was 2.0 \(\times\) 10^{15}/\text{cm}^2 and the mean diameter and height were 25 nm and 5 nm, respectively. After the formation of InAs QDs, GaAs capping layer was grown. The photoluminescence (PL) of the sample was measured using InGaAs cooled-CCD detector. We used a Ti:Sapphire femtosecond laser with the peak wavelength of 760 nm as the excitation source. PL spectrum of InAs quantum dots at room temperature was shown in Fig. 1.

The excitation power density was 50 W/cm^2. The emissions from the ground and excited states can be observed at 1347 nm, 1248 nm and 1159 nm, respectively. We also observed the very weak emission from the wetting layer at 937 nm.

Secondly, we studied the PL spectrum of InAs QDs in strained InGaAs QW. After the formation of InAs QDs, a 5 nm strained InGaAs QW was grown, and capped by GaAs. The cross-sectional scanning tunneling microscope (SEM) image of this sample is shown in Fig. 2(a). The diameter and height of InAs QDs were 20 nm and 5 nm, respectively. We investigated the PL peak wavelength by changing the indium composition of strained InGaAs QW. The excitation power density was 2.5 W/cm^2. With increasing the indium composition of strained InGaAs QW, the peak wavelength of InAs QDs shifts towards longer wavelength, and we can observe 1.52-\(\mu\)m emissions from InAs QDs in In_{0.45}Ga_{0.55}As QW (Fig. 2(b)). In summary, we have successfully observed over-1.5-\(\mu\)m emissions at room temperature of InAs QDs grown by MOCVD. By capping InAs QDs with strained InGaAs QW instead of GaAs, the PL peak wavelength shifts towards longer value, and we have achieved 1.52-\(\mu\)m emissions of InAs QDs in In_{0.45}Ga_{0.55}As QW.

Reference


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