

Article

Electronic and Optical Properties of InAs QDs Grown by MBE on InGaAs Metamorphic Buffer

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Introduction

Here, we present the results of photoluminescence (PL) measurements of all structures A-E (see Table 1), on the basis of which the temperature dependence of PL (Figure 5, 6 and Table 2) and linear polarization dependence of PL (Figure 4), presented in the main text of the manuscript, were determined. Additionally, we attach full experimental data of microphotoluminescence (μ PL) measurements as a function of excitation power (shown partially in Figure 9b) on the basis of which the dependence of single emission line intensities was determined (Figure 10a).

1. Polarization-resolved photoluminescence

For all the structures characterized by the emission shown in Figure 2, measurements of the polarization-resolved PL were performed. Figure S1 shows the experimental data for all the structures. They served as a base of the degree of linear polarization analysis shown in Figure 4.

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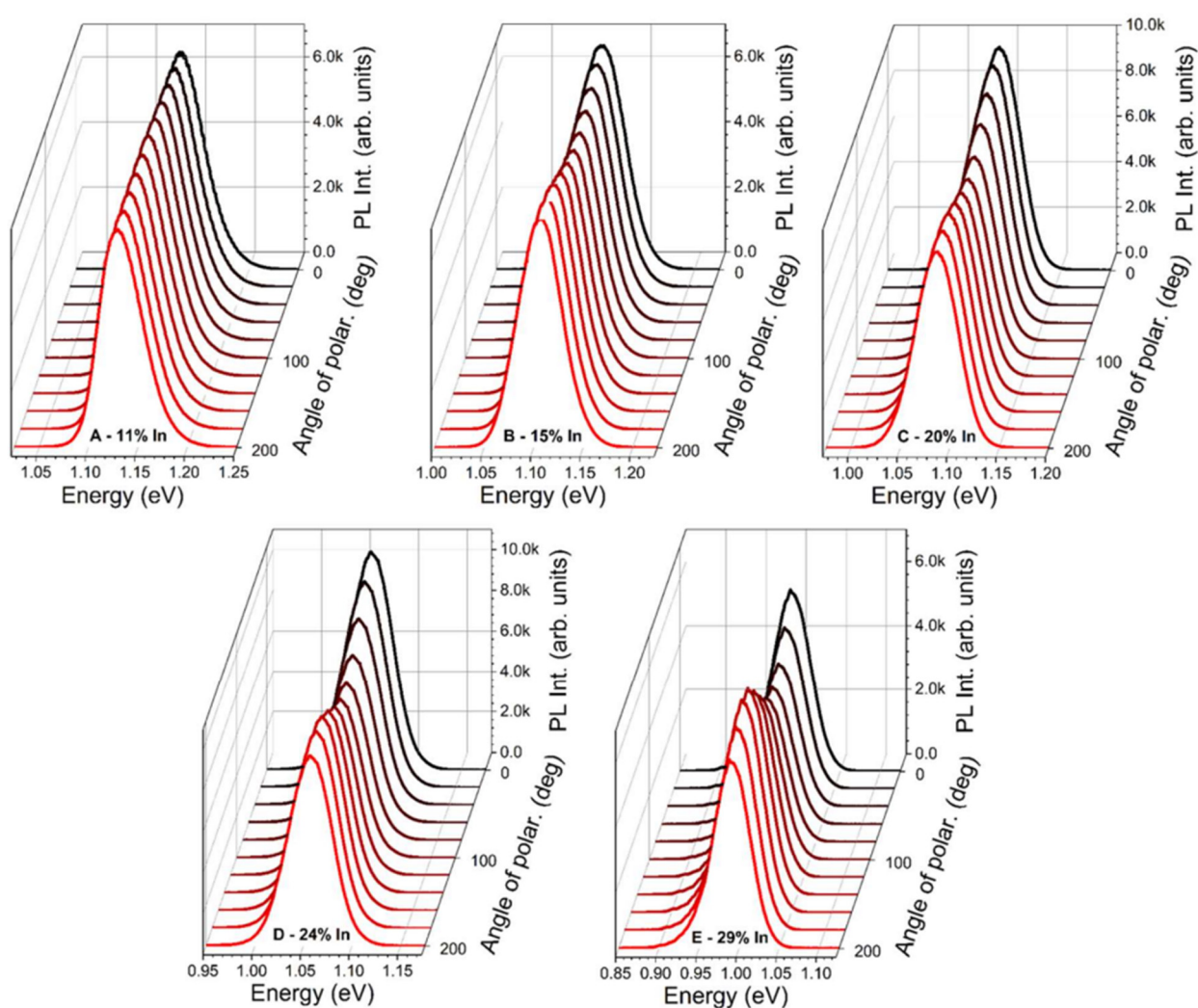


Figure S1. PL spectra for structures A-E in the function of linear polarization angle (the scale of polarization angles in the experimental setup coordination system). .

The obtained spectra were integrated in order to determine the PL intensity as a function of the linear polarization angle and then fitted using Formula (1), which allowed determining the degree of linear polarization.

2. Temperature-dependent photoluminescence

In this section, we present the results of photoluminescence measurements as a function of temperature for all the structures on the basis of which the influence of the sample temperature changes on the emission could be analyzed in particular, the thermal carrier activation energies and hence the related carrier loss mechanisms in these quantum dots could be determined. Figure S2 shows the temperature-dependent photoluminescence measurements for all the investigated structures.

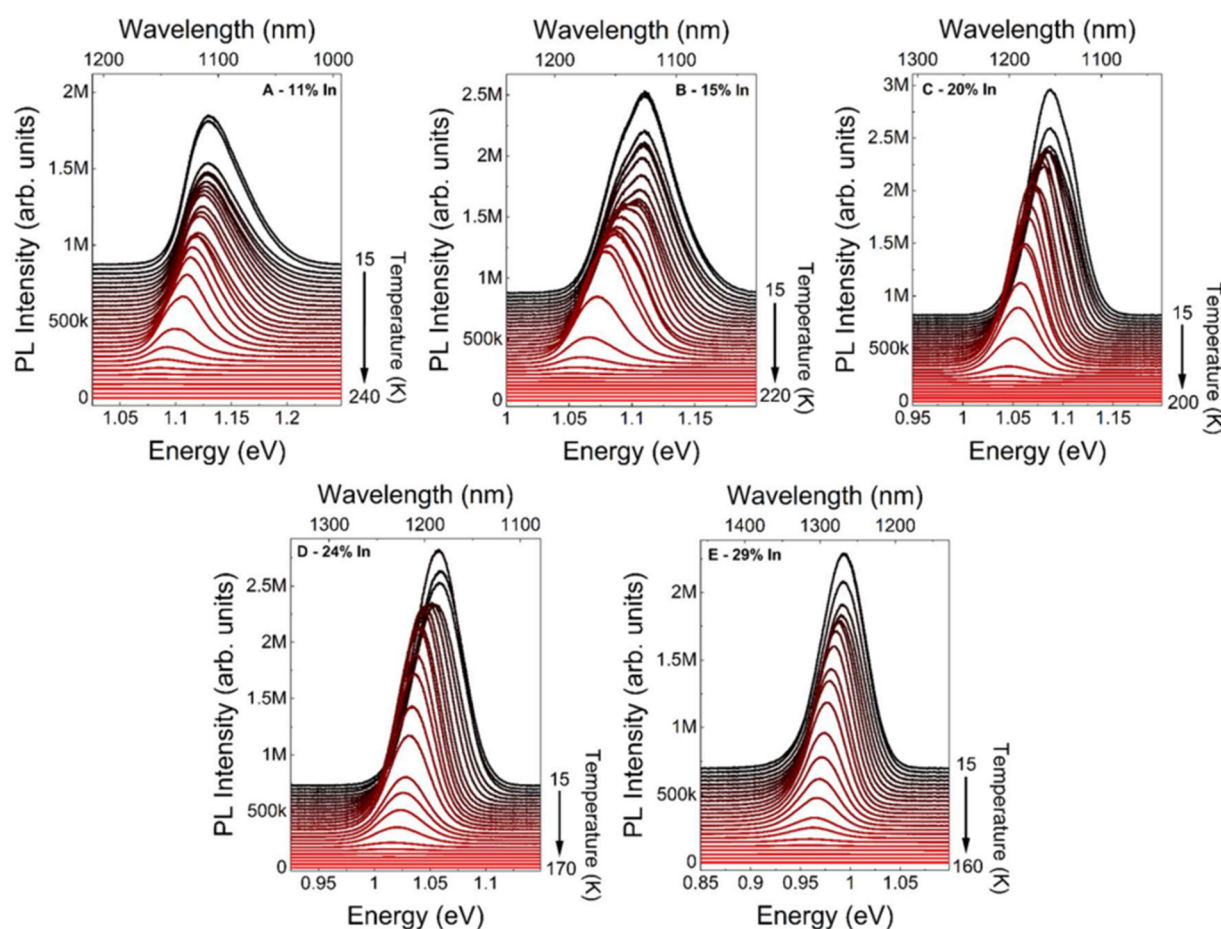


Figure S2. PL spectra for structures A-E in a function of temperature.

These spectra were next fitted with Gaussian equation to establish the emission peak energy and full width at half maximum (FWHM), and integrated to determine the intensity of the PL vs temperature for the ensemble of QDs. The results of this analysis are presented in Figures 5 and 6.

3. Power-dependent microphotoluminescence

In order to characterize the emission from single QDs, μ PL excitation power dependence measurements were carried out. Figure S3 presents the full results of measurements for the selected mesa structure, which are selectively presented in Figure 9b. On the basis of these data, the dependence of μ PL intensity was determined versus the excitation power, which are presented in Figure 10a for selected lines marked as X and XX.

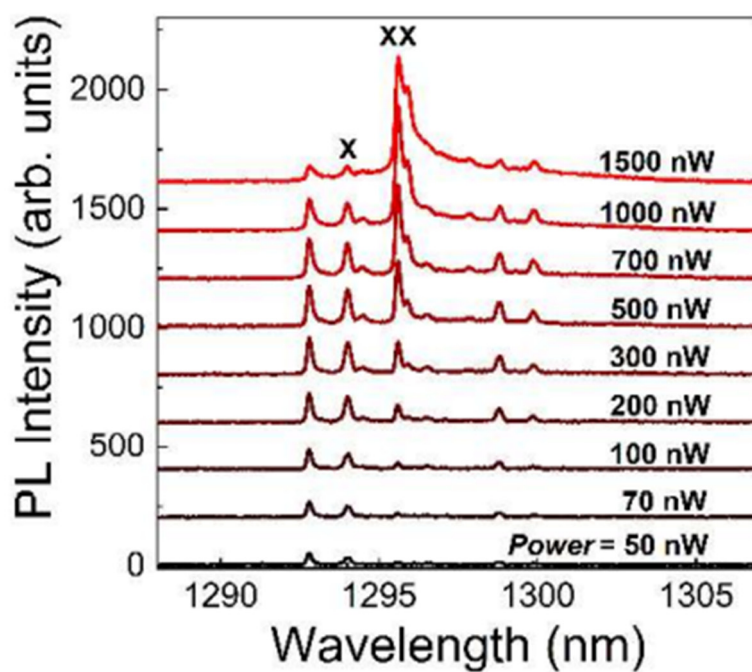


Figure S3. μ PL spectra for a selected mesa in a function of the excitation power.

The obtained spectra were integrated for particular lines to determine μ PL intensity and then fitted using the three-level rate-equation model (ref. 72 in manuscript). The results of this analysis are presented in Figure 10a.