"Improved Methodology to Nucleate $Zn_xCd_{1-x}Se$ cladded $Zn_yCd_{1-y}Se$ Quantum Dots using PMP-MOCVD for Lasers and Electroluminescent Phosphors"

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Earlier, we have reported growing 3-8 nm CdSe and pseudomorophic $Zn_xCd_{1-x}Se/Zn_yCd_{1-y}Se$ cladded quantum dots (QDs) ($x > y$) in a novel Photo assisted Microwave Plasma Metalorganic Chemical Vapor Phase Deposition (PMP-MOCVD) reactor [1, Angel *et al.*] Influence of growth parameters including microwave power, ultraviolet intensity, gas phase II/VI [Zn+Cd/Se] molar ratio, temperature of growth, and post-growth processing was investigated. This paper reports improvement in uniformity of dots nucleated by a methodology which preheats the reaction zone prior to the initiation of Microwave Plasma in a metalorganic chemical vapor deposition (MOCVD) The grown dots, shown in Fig. 1 are compared with those reported before [1]. They are also compared with dots prepared by other methods [2, 3, see Fig. 3 and Fig. 4], both using high-resolution transmission electron microscopy (HR-TEM).

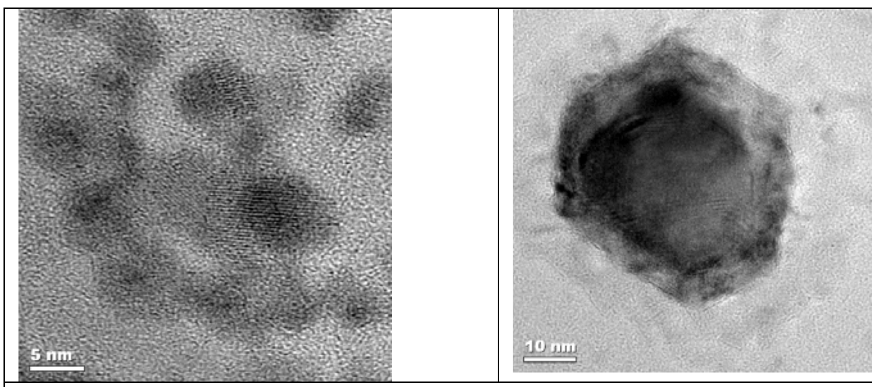


Fig. 1. CdSe quantum dots grown in preheated cavity via PMP-MOCVD.

(a) (b)

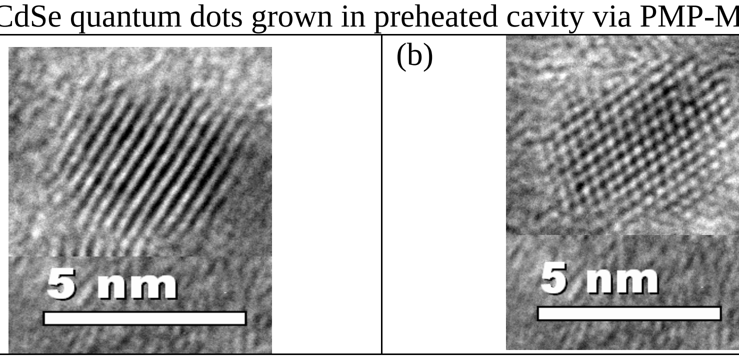


Fig. 2. CdSe quantum dots grown using PMP-MOCVD technique [1].

It has been shown [1] that photoluminescence (PL) peaks and full width at half maximum (FWHM), and X-ray diffraction (XRD) data have been used to calculate dot size. Comparison of X-ray diffraction peaks are shown in Fig. 5 and 6, respectively.

The influence on PL intensity of this new methodology is under investigation. We have also simulated the optical gain of cladded quantum dots including the effect of strain in the cladding for different composition of cladding layer. These results are shown in Figs. 7 and 8. Simulation is based on excitonic model reported by Jain and Huang [JAP, 1999] with some modification.

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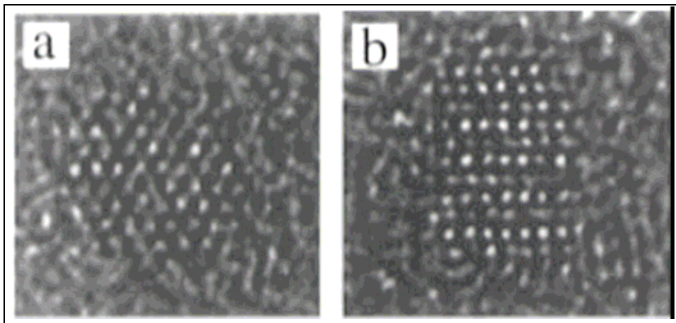


(a) Wurzite c-axis (b) Wurtzite a-axis.
Fig. 3. CdSe quantum dots grown by colloidal method (Peng *et al.*, JACS, 1997, Ref.2].

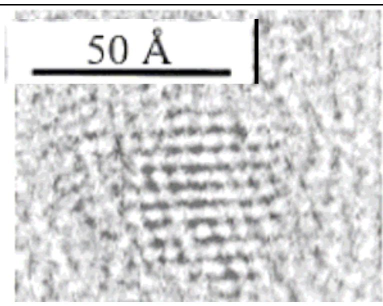


Fig. 4. CdSe quantum dots grow n by colloidal method
[Dabbousi *et al.*, JPCB, 1997; ref 3].

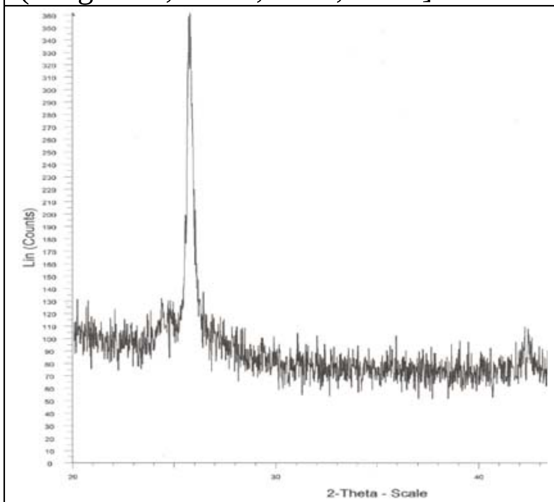


Fig. 5 X-ray diffraction data on dots shown in Fig. 1.

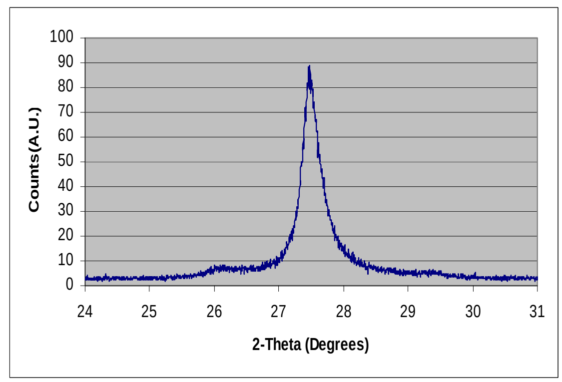


Fig. 6. X-ray peak from QD ensemble shown in Fig. 2 with out preheating [1].

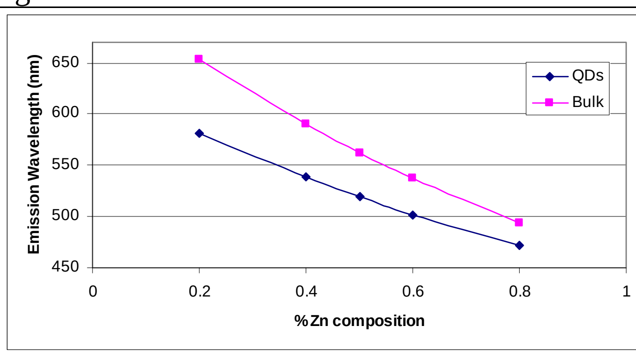


Fig. 7. Emission peak as a function of Zn fraction.

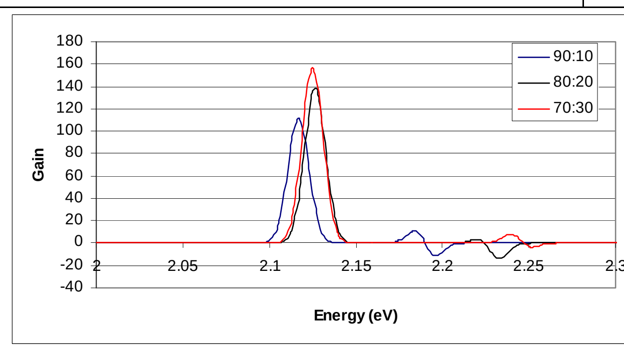


Fig. 8. Optical gain of $Zn_xCd_{1-x}Se$-CdSe QDs as a function of band offset ratio [$\Delta E_c/\Delta E_v$].

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