



Proposed Transmission Electron Microscopy (TEM) Studies on Quantum Dots and Heterostructures



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The Condensed Matter Physics Laboratory

The Semiconductor Group of CMPL does research on the growth and characterization of InAs quantum dots and heterostructures.

Our competencies:

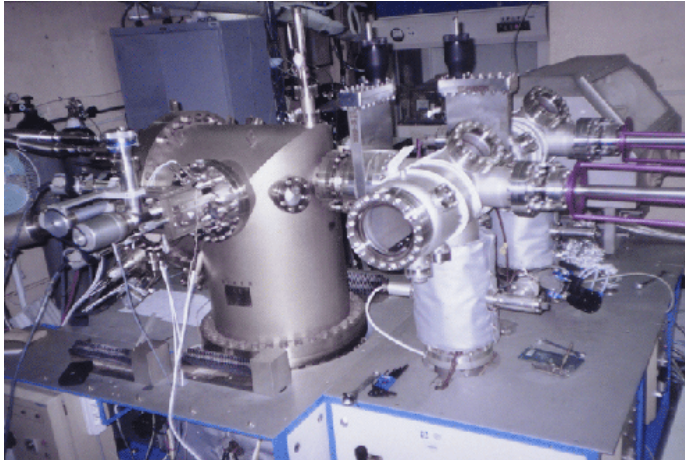
- Growth of Quantum Dots & Pseudomorphic Epitaxial Layers
- Characterization
- Device Fabrication

We manage to survive through funding from the Department of Science & Technology and donations from private companies.

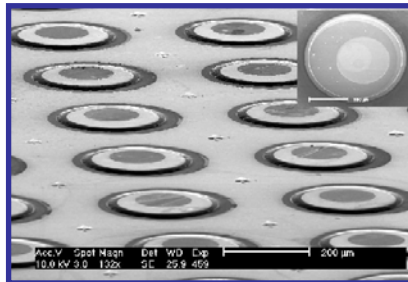
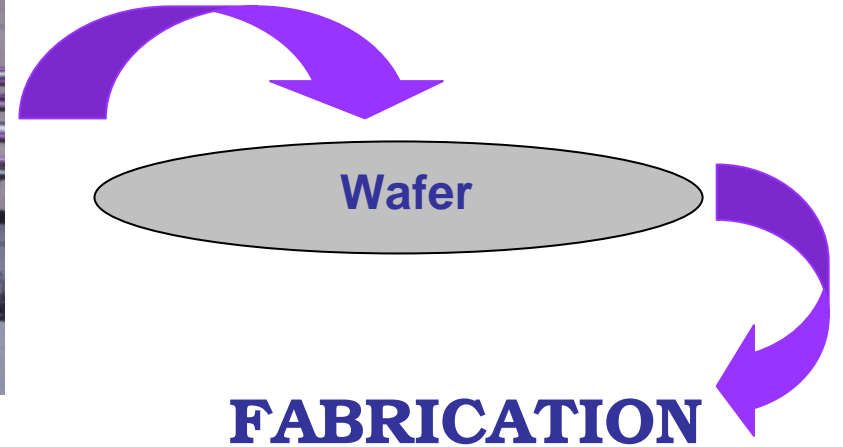


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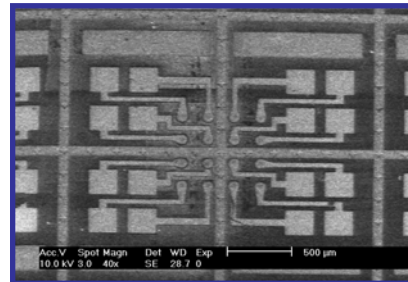
Molecular
Beam
Epitaxy
Facility



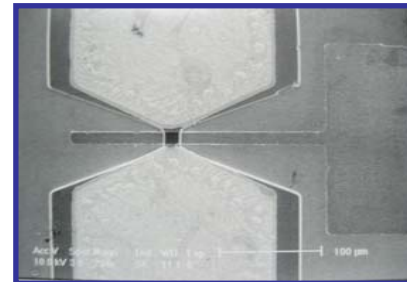
SAMPLE GROWTH



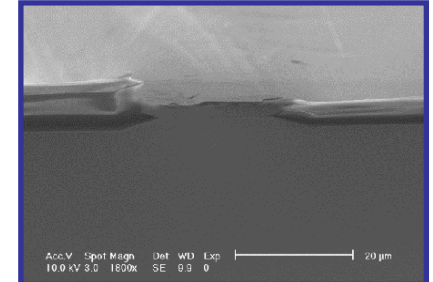
array of
VCSELs/RCEs



4x4
configuration of
photodetectors



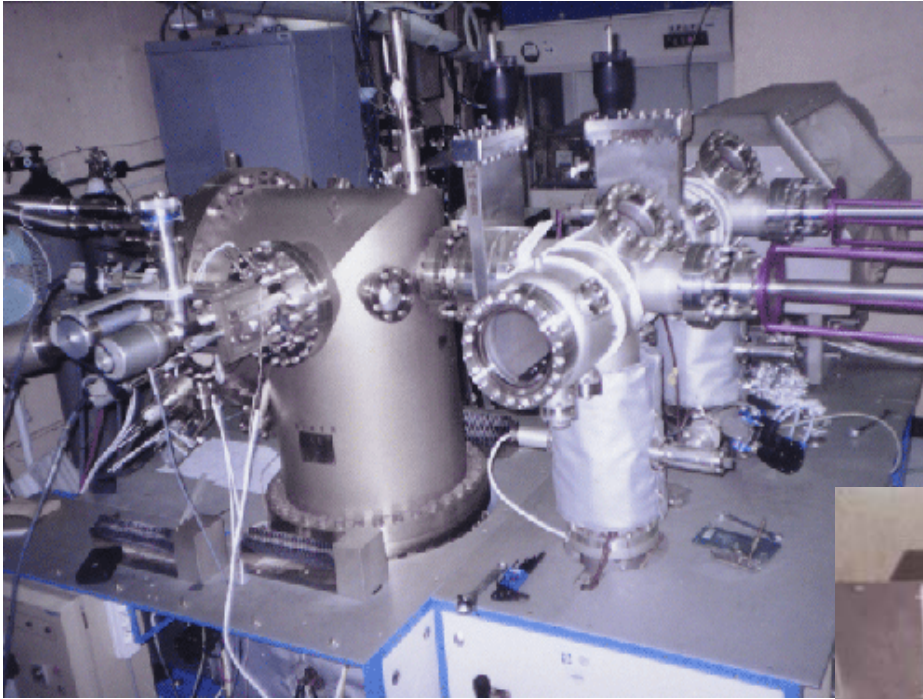
transistor



edge-emitting
laser

DEVICE TESTING

Growth Facility



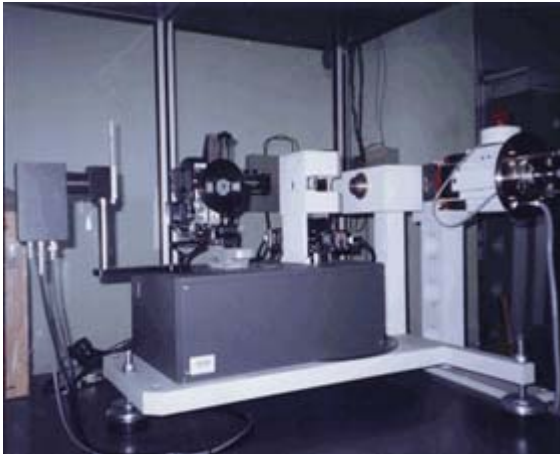
**Molecular Beam
Epitaxy Facility**



cmpl

<http://www.nip.upd.edu.ph/cmpl>

Device Characterization Facilities



**Scanning Electron
Microscope
with EDAX**

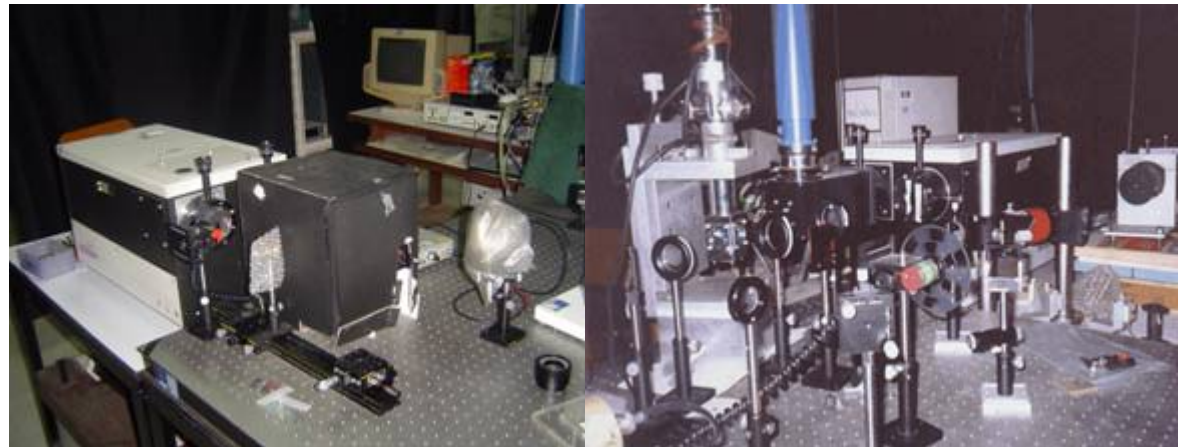
**X-Ray
Diffractometer**



Raman Spectroscopy Set-up



Optoelectronic Characterization Set-up



Device Characterization Facilities

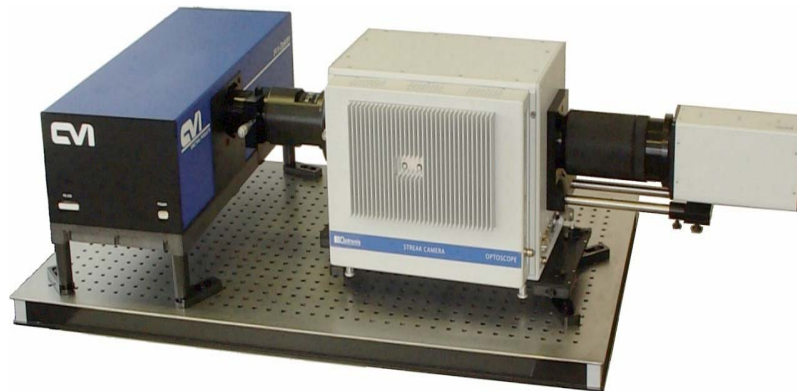
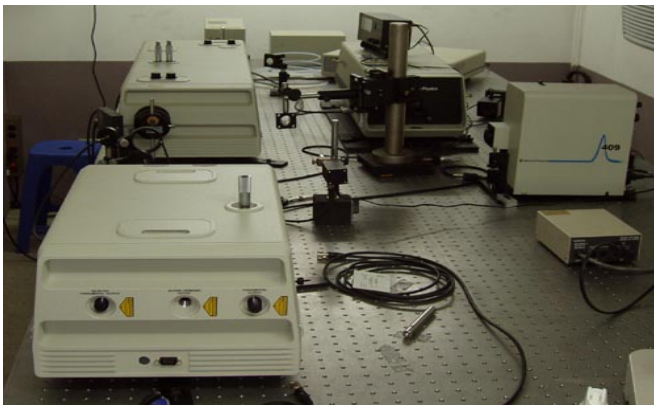


**Curve
Tracer**



**Optical
Microscope**

Femtosecond Laser & Streak Camera System



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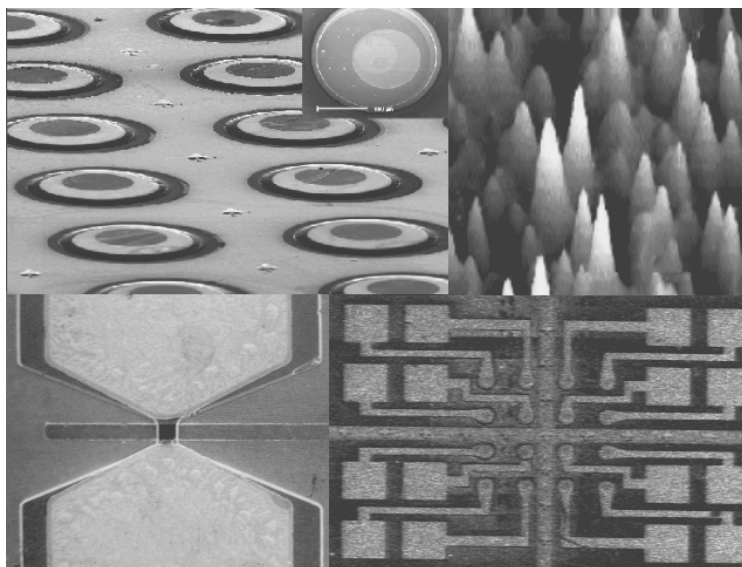
Oxidized RCE photodetectors

Oxidized
VCSELs

High-speed
photodiode

transistors

manpower
development



InAs quantum
dots

Edge-emitting
lasers

4x4 complex
array

collaborations

publications
and citations

What we need...

Transmission Electron Microscopy (TEM) studies on our samples

- to probe the morphology and sizes of the quantum dots
- to examine the nucleation
- to investigate the quality of the layers



Our work on stacked quantum dots



ELSEVIER

Available online at www.sciencedirect.com



Journal of Crystal Growth 251 (2003) 196–200



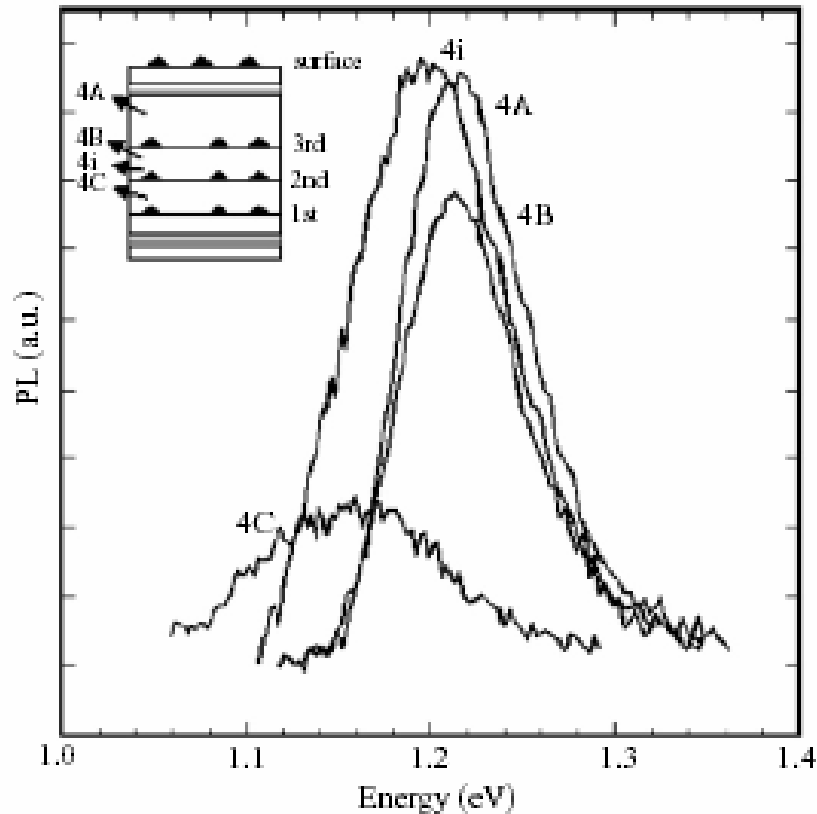
www.elsevier.com/locate/jcrysgro

Observation of blue-shifted photoluminescence in stacked InAs/GaAs quantum dots

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Our work on stacked quantum dots



- Shifting towards high energy of the photoluminescence (PL) was observed in vertically stacked InAs quantum dots

Our work on *in situ* annealed quantum dots

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COMMUNICATIONS

Raman spectroscopy of *in situ* annealed InAs/GaAs quantum dots

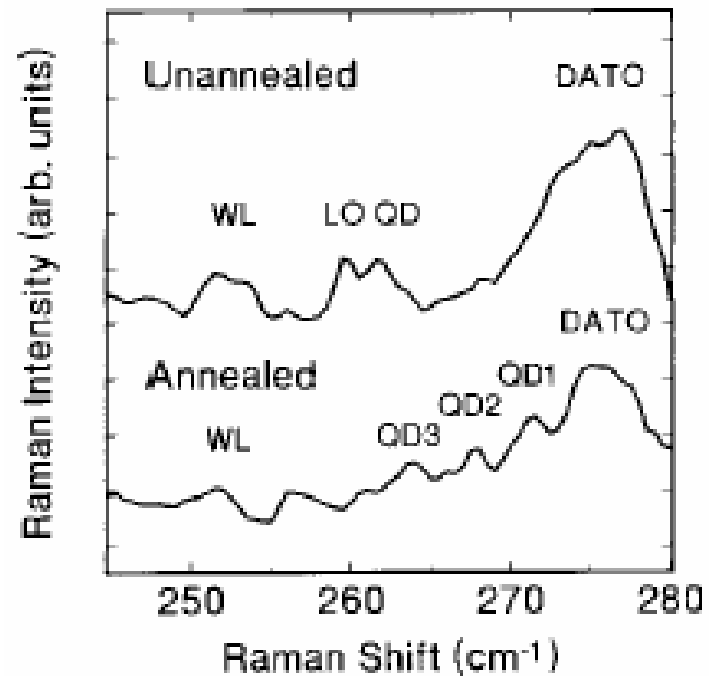
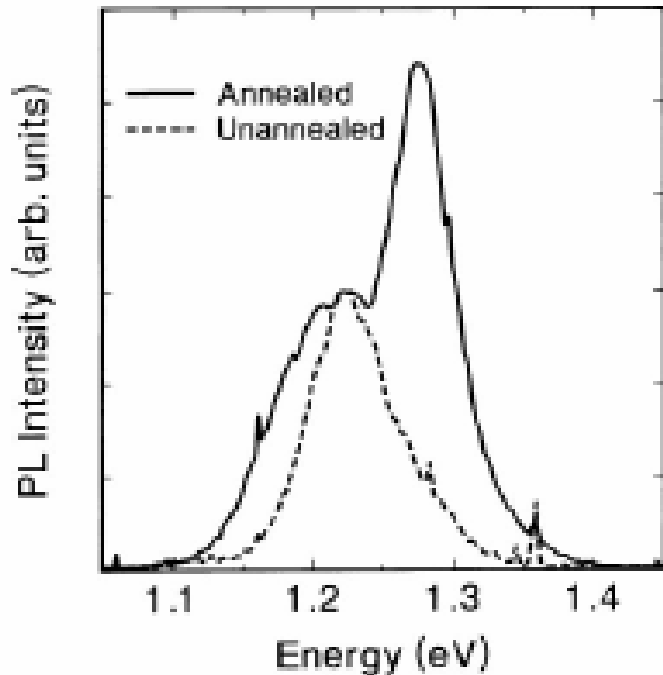
M. J. M. De Luna,^{a)} A. Somintac, E. Estacio, and A. Salvador^{b)}

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(Received 14 November 2003; accepted 26 April 2004)

Nonresonant Raman scattering measurements were performed on a three-layered sample of *in situ* annealed InAs/GaAs self-assembled quantum dots. The thermal annealing step was done during the growth of each GaAs spacer layer, where the substrate temperature was raised from 530 °C to 580 °C as measured by a pyrometer. Three Raman signals are clearly seen at 264 cm⁻¹, 268 cm⁻¹, and 271.5 cm⁻¹ which can be attributed to the longitudinal optic (LO) phonons of the dots. These three different signals are attributed to different degrees of In/Ga alloying or intermixing in each dot layer as a consequence of the different thermal treatments that each layer was subjected to. The Raman signal of the wetting layer (WL) is remarkably weak and suggests erosion of the wetting layer. In contrast, Raman scattering measurements on an unannealed sample show two overlapping features at 259.5 cm⁻¹ and 261.5 cm⁻¹ which are attributed to the LO phonons of the dots. The WL signal is clearly observed at 251.5 cm⁻¹. To support our Raman observations, the appearance of a strong higher-energy peak in photoluminescence measurements suggests that alloying did occur in the annealed sample. © 2004 American Institute of Physics. [DOI: 10.1063/1.1762993]

Our work on *in situ* annealed quantum dots



Low temperature PL and Raman measurements performed on InAs quantum dot samples

➤ annealing causes alloying

Our work on quantum dots and heterostructures can be further extended.

We need T.E.M.



<http://www.nip.upd.edu.ph/cmpl>



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