Research Highlights

THE AUSTRALIAN NATIONAL UNIVERSITY

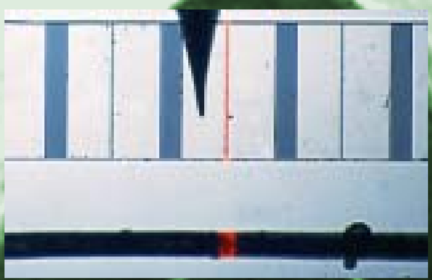
Research School of Physical Sciences and Engineering

Taking the Strain out of Quantum Lasers

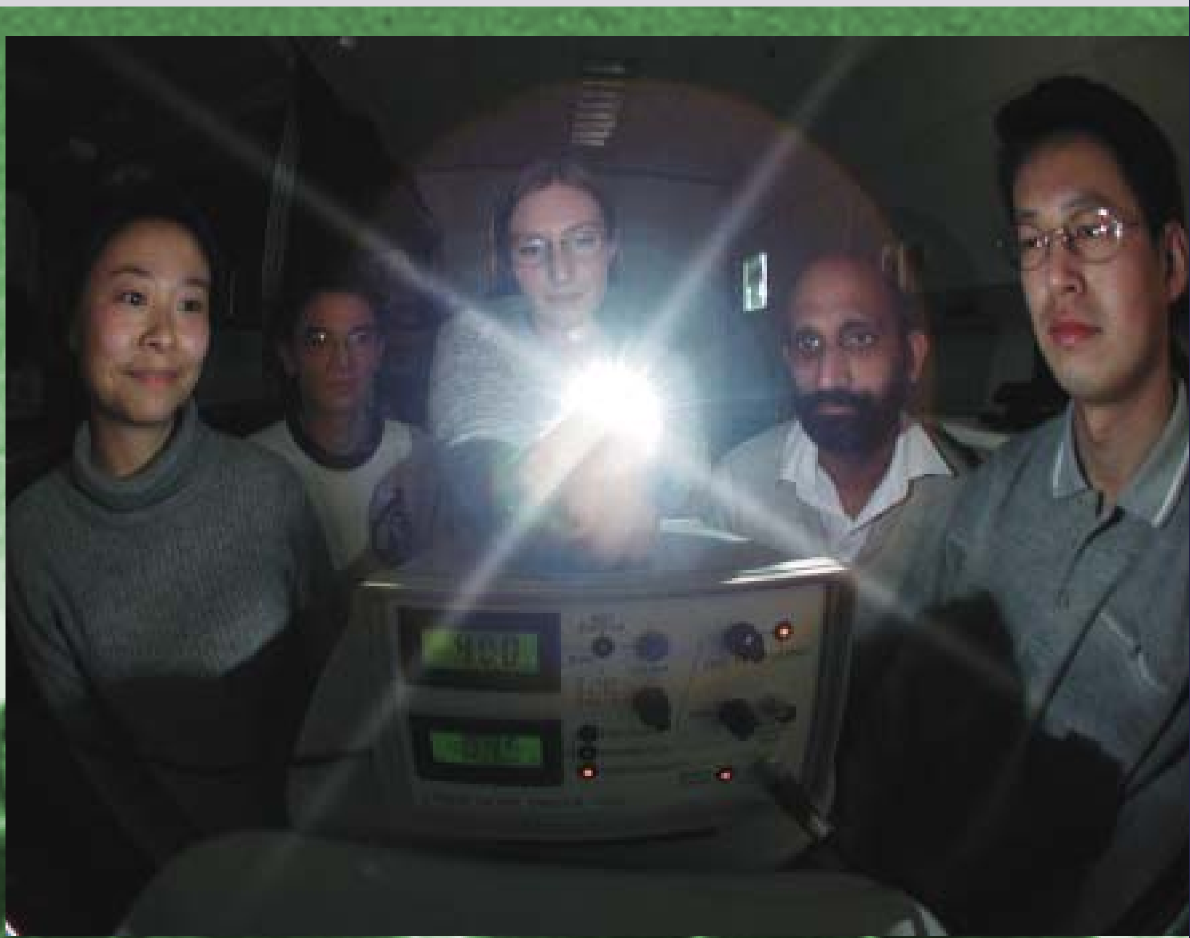
Hoe Tan, Penny Lever, Kallista Stewart, Fu Lan, Qiang Gao, Sudha Mokkapati, Satya Barik, Michael Fraser, Greg Jolley, Manuela Buda, Jenny Wong-Leung, Chennupati Jagadish

When different layers of different semiconductors are grown on top of each other, the foreign atoms don't naturally want to have the same spacing as the host layer. This can lead to strain deformation and even cracking in extreme cases. However lattice mismatch phenomena can also produce interesting growth phenomena such as - quantum dots.

A quantum dot is a tiny island of one type of semiconductor within a different material. Because of its extreme small size, electrons within the dot don't behave as they would in bulk material. By engineering these dots carefully, it is possible to build advanced lasers and detectors with properties that would be impossible to achieve in normal fabrication techniques.



Microscopic quantum laser illuminates a human hair



Where the problems come is that the strain conditions needed for good dots don't marry with those need for good laser performance. The solution to this until now, has been a growth technique known as Molecular Beam Epitaxy (MBE). The trouble with MBE is that it's too slow and laborious for economical industrial applications.

Recent research at the ANU, has demonstrated that under the right conditions, a much faster growth method Metal Organic Chemical Vapour Deposition (MOCVD), can be used to create excellent quantum dots. The secret behind the ANU success, is to alleviate undesirable strains by growing extra compensation layers with the opposite strain to the laser layer. It's a bit like prestressed concrete, where the material is cast with one strain to help it cope with the opposite strain.

Scientists at the ANU are amongst only a handful in the world to be able to grow quantum dot lasers by MOCVD. The new growth techniques are now being applied to lasers of specific interest for optical communication applications.