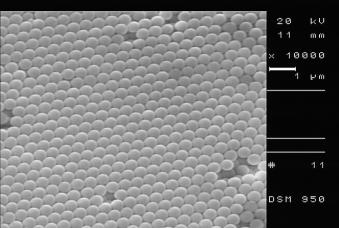
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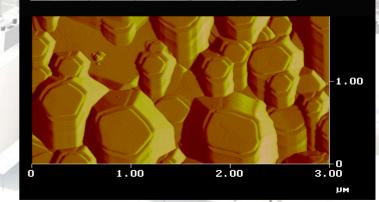
MICRONOVA

CENTRE FOR MICRO- AND NANOTECHNOLOGY

Optoelectronics Laboratory

- Employees: 19 (13 graduate students) – professor Harri Lipsanen (nanotechnology), open: physics(optoelectronics) and photonics
- Fields of research
 - optoelectronics and integrated optics
 - compound semiconductor technology
 - nanotechnology, quantum structures
 - optical spectroscopy, x-ray diffraction
- Teaching
 - majors: photonics, nanotechnology,
 physics in electrical engineering
 - Master's Programme in Micro- and Nanotechnology







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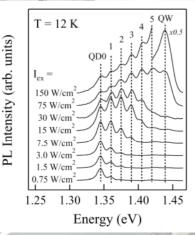
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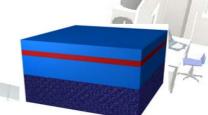
Research in Optoelectronics

Fabrication of compound semiconductor structures by metalorganic vapour phase epitaxy





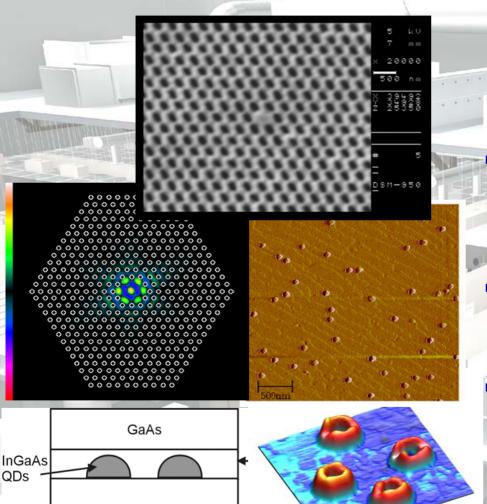
Materials characterisation by optical spectroscopy, x-ray diffraction and atomic force microscopy





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GaAs

Advanced semiconductor structures

 Development of self-assembled quantum dot structures and photonic crystals for novel optoelectronic devices

 Gallium nitride technology for blue emitters and high-temperature electronics

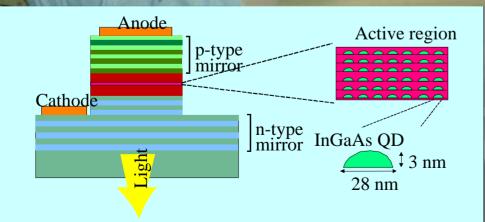
GaAs and InP technology for infrared applications



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Component processing

 Devices: diode lasers, LEDs, detectors, optical waveguides, microcavities and photonic crystals

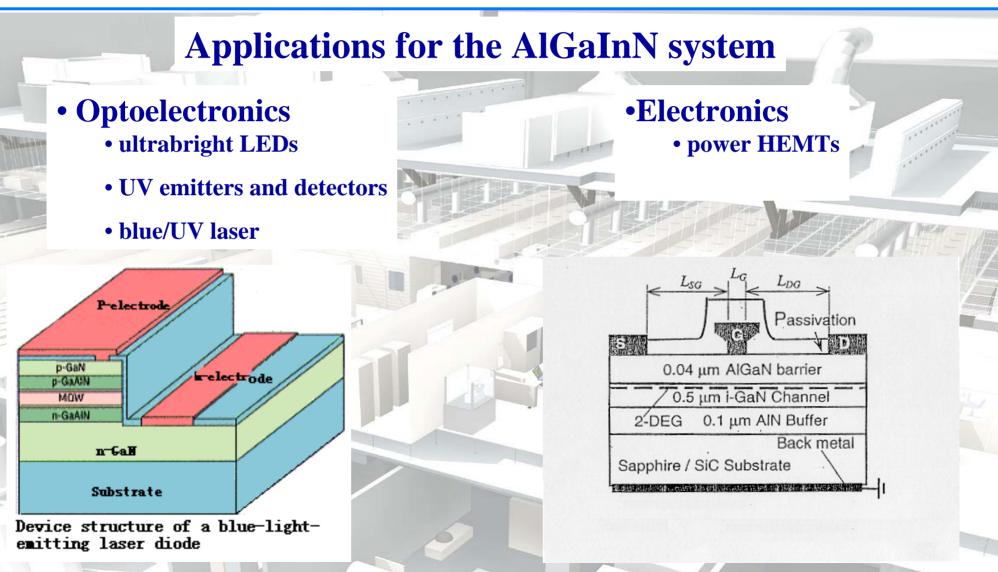
 Processes: lithography, dry etching, metallisation, etc.

Materials: GaAs-based, InPbassed, GaN-based, InAs, GaSb, SOI

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•Objectives

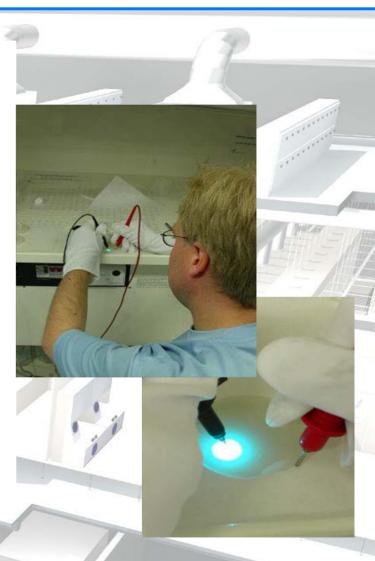
2-year target:a) optically pumped lasing
b) electrically pulsed laser diodelong term target:cw blue laser

Materials research

- MOCVD growth of AlGaInN compounds on sapphire with reduced dislocation density
- improved GaN buffer layers on sapphire

• Device research

- high efficiency emitters by improvement in material quality, p-type doping
- development of GaN processing by ICP-RIE



TEKNILI

a)

Optoelectronics Laboratory

b)

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1x

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4x

GaN nucleation on sapphire

•A cyclic method for nucleation layer optimization

 $2\mathbf{x}$

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EPITAXY:

MOCVD system for GaN epitaxy Thomas Swan 3x2" CCS reactor

MATERIALS GROWN: GaN, InN, AlGaN, InGaN

MOCVD system for III-V epitaxy: 1" horizontal reactor TECHNOLOGY

MATERIALS GROWN: GaAs, InP, InAs,... InGaAs, InGaP, GaAsN,... GaInNAs, InGaAsP,...

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Vertical 3 x 2" showerhead reactor
growth of gallium nitride and other III-V's (arsenides and phosphides)
real-time optical monitoring of growth (layer thickness, surface temperature...)
excellent uniformity of thickness and alloy composition
suitable for both research and production

T_{max} = 1200°C SiC coated graphite susceptor

> rotating disk



The CCS is an innovative approach to MOCVD reactor design based on the stagnant point concept. Reagents enter the stainless steel, quartz lined reactor chamber through a water cooled showerhead close to the sapphire substrates. The showerhead has separate injection for NH3 and TMGa. The substrates are placed on the top surface of a rotating susceptor which is resistively heated. The three zone heater enables an appropriate temperature profile to be set up across the susceptor for optimisation of uniformity. The profile is monitored through optical pyrometer ports through the showerhead. The growth temperature is controlled from transducer at the underside of the susceptor. Exhaust gases pass around the susceptor, upon exiting the chamber the gas passes through a filter medium to protect the vacuum system from contamination.

CCS offers the advantage of a wider process parameter space, improving process stability and uniformity of both layer thickness and alloy composition.



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