Epitaxial growth of laser diodes operating at the telecommunication wavelength

Semiconductor lasers find applications in many areas of our everyday life due to their low cost, high performance and a small footprint. The emission wavelength of a laser diode depends on the bandgap energy and the shape of the gain material where the carriers are localized and recombine by the emission of a photon. The waveguide layer should have sufficient refractive index contrast with the cladding layers in order to confine the light. The doping of cladding layers has to provide high conductivity for the carriers to the active layer, but should not introduce extra optical losses. Additionally, extra layers like etch stop layers with very different chemical compositions have to be introduced to the structure for fabrication purposes. To achieve the required laser characteristics the design of the device has to be very well thought through. All the layers have a different chemical composition but still form a single crystal with the substrate without crystal defects.

In this project the student will develop an epitaxial process of for III-V semiconductor laser diodes operating at the telecommunication wavelength of 1.55 µm. This project will involve device simulations, epitaxial growth and basic material characterization, both optical and structural.

Skills/knowledge acquired for the project:
- Basic principle of laser device design
- Basic principles of epitaxial growth
- Material characterization techniques
  - Photoluminescence (optical properties)
  - High resolution x-ray diffractometry (crystal structure properties)
  - Scanning electron microscopy (morphology characterization)

Background requirements:
- Knowledge of solid state/semiconductor physics

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