Project 6.5 AlInGaN laser diodes and micro LEDs with active regions shaped as micro ribbons and discs fabricated on corrugated substrates

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Background:

The III-N semiconductor emitters are the heart of many types of optoelectronic systems around us, including LED lightbulbs, car headlights etc. This material system offers a unique opportunity of fabricating emitters operating in the exceptionally broad spectral range – in principle from UV to even infrared. In reality, utilization of such a wide range is limited by technical difficulties related to the material properties. That is, the difference in lattice constants of the binary materials InN, GaN and AlN. As a consequence, the grown heterostructures are highly strained which leads to negative effects such as defect formation, cracks in the material or spatial segregation1 of indium in InGaN layers (especially quantum wells, used as a heart of the light emitting system for most of the spectral range). Though, the dramatic improvement in the quality of green InGaN laser diodes was recently observed, their parameters still lag behind their shorter wavelength counterparts. The situation is even more difficult for high In content - InGaN red emitters.

Aim:

The goal of this project lies in the development of InGaN/GaN active region for AlINGaN light emitters in a form of micro and sub-micro ribbons and discs. Depending on the details of the shape and size of the pattern before epitaxy, we can obtain significant increase of the indium content in InGaN quantum wells, thanks to the reduction of the strain. We also expect to improve the device work parameters thanks to improved carrier confinement (micro-LED, lasers) and light confinement (lasers).

Requirements:

- knowledge of solid state physics, with particular emphasis on the physics of semiconductors, particularly preferably knowledge of the physics of AlInGaN semiconductors,
- experience in optical characterization, such as photoluminescence and electroluminescence, is welcome,
- experience in working in a cleanroom environment would be an advantage,
- fluent oral and written English,
- A Master degree in physics, electronics or materials engineering
- knowledge of Origin, MS Word, MS Excel