

Project 4.3 Molecular beam epitaxial growth and characterization of light emitting diodes (nanoLEDs) based on nanowires of nitride semiconductors

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Background:

Due to one-dimensional shape of nanowires elastic relaxation of strain in such structures is very efficient. Therefore, even if segments of materials having very different lattice parameters are put together or if nanowires are grown on substrates with a large lattice mismatch, they are of very high structural quality without extended defects. This allows formation of complicated heterostructures of the quality that cannot be achieved in reference planar structures. This is crucial for optoelectronic devices in which structural defects are known as light emission killers. In particular, nitride semiconductors, e.g. gallium nitride GaN and its alloys with indium and/or aluminum, are perspective materials for modern optoelectronics. Their wide direct energy bandgap allows light emission in the short wavelength range of the visible light spectrum. In addition, these materials exhibit unique physical and chemical properties making nitride nanowires the most perspective building blocks of next-generation semiconductor devices.

Aim:

The aim of the project is to develop growth technology by molecular beam epitaxy (MBE) of light emitting diodes (nanoLEDs) nanostructures based on GaN nanowires with axial GaN/AlGaN/InGaN heterostructures and p-n junction. An impact of the growth conditions and the design (choice of substrate, composition and layers layout, geometry, doping, etc.) on properties of the structures will be studied. Test nanoLED structures will be fabricated to determine conditions necessary for the highest electroluminescence efficiency in the optimized devices. Mastering of the MBE growth of nitride semiconductors, processing of semiconductor materials (lithography, deposition of thin metallic and dielectric films) as well as testing of materials by electrical and optical techniques will be needed for successful realization of the project.

Collaboration with Institute of Photonics and Electronics of the Czech Academy of Sciences, Prague, Czech Republic is planned.

Requirements:

- experience in MBE growth of semiconductor nanostructures,
- Master's degree in physics, material engineering, chemistry, electrical engineering or electronics or related field,
- good spoken and written English,
- high motivation for scientific work

Funding:

Scholarship: NCN grant P-548 funding of 5000 PLN per month, before subtracting obligatory employer and employee social security contributions (~15%), for 36 months. Afterwards, standard Polish PhD scholarship (3640 PLN/month net).

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