

Project 6.3 Design, fabrication and characterization of multi-junction distributed feedback laser diodes

Supervisor: prof. Czesław Skierbiszewski, PhD Dsc. / Grzegorz Muzioł, PhD Eng.

Institute: Institute of High Pressure Physics Polish Academy of Sciences

Unit: NL-14

www: <https://www.unipress.waw.pl/mbe/en>

Background:

The project is devoted to the development of a completely new optoelectronic device – a multi-junction laser diode with distributed feedback. This device contains several pn junctions connected by tunnel junctions. The advantage of this scheme is that for the same current flow, light emission occurs in each of the quantum wells. One can expect N times the output power of a multi-junction laser with N sections. This results in a differential efficiency (photons per injected electrons) higher than 100%, at the cost of the additional voltage required for each section. A diffraction grating placed on the surface of the device will ensure strong coupling with the optical mode and lasing at only one wavelength - the one that matches the grating.

The demonstration of visible multi-junction laser diodes with distributed feedback will open up a new field of GaN-based devices and stimulate new research directions. The project will be carried out in cooperation between the Institute of High Pressures of the Polish Academy of Sciences (IWC PAN), CEZAMAT of the Warsaw University of Technology and the group of Prof. Ulrich Theodor Schwarz of the Technische Universität Chemnitz.

Aim:

The project will be carried out in the research work of the OPUS LAP project entitled “Multi-junction distributed feedback laser diodes – synergy of high optical power and single-mode operation”. The PhD student will conduct the growth of group III metal nitride heterostructures by molecular beam epitaxy, in particular the growth of multi-junction laser diodes. In addition, she will perform basic characterization of grown structures, in particular AFM, DSE, PL, EL, CL and XRD.

Requirements:

- Master's degree in physics or materials engineering or electrical engineering (or equivalent to enter a PhD program in physics in the country of issue),
- very good knowledge of English,
- programming skills in one of the following languages: Python, C++ or similar,
- knowledge of semiconductor physics.