Present electronics sometimes is described half-jokingly by „GaNification" because GaN, as well as AlN and InN make a real technological revolution. The best known application of nitride semiconductors are: white LEDs and violet laser diodes used in BluRay recorders and players. Recently, white LEDs are replaced by laser lamps (for example, in Audi and BMW cars) which have a longer illumination distance and which can be used for much faster LiFi communication (data transmission using light) than in the case of LEDs. An enermous market which should emerge soon are RGB (red, green, blue) laser projectors, in which the green and blue light will be obtained from nitride-semiconductor-based lasers, the red light will be from (AlGaIn)(AsP)-based lasers. The RGB projectors will have a superb colour resolution and will pave a way to 3D emission without goggles. These mass markets will be overcome by large companies. Polish chance is in the niche markets- of atomic clocks, mass spectrometres, in spectroscopy, medicine, scientific research and in military applications.

Unfortunately, the nitride semiconductors are very difficult to be grown and processed. Main part of the LEDs and laser diodes, where light is generated, is InGaN. It must be grown at very low temperatures what results in a high density of defects, and in particular, in indium fluctuation. Such inhomogeneity influences strongly the optical properties and therefore, this issue belongs to the most important problems in nitride optoelectronics industry.

Research on indium fluctuations in InGaN is being conducted in many laboratories, but, in fact, there is no reliable method to examine the InGaN microstructure. Optical methods give indirect information, and in electron-microscopy is done using only very small samples. The most popular method of crystalline semiconductor characterization is X-ray diffraction. However, till now there has been no good theory of X-ray scattering which could be used to examine InGaN (with indium fluctuations) or other non-perfect crystals.

Such theory has been created by Vaclav Holy (Charles University in Prague) in collaboration with us. It is an advanced theory, but it has still many simplifications. The aim of of this Project is an experimental verification if these simplifications are justified. In the Project, we will grow InGaN layers using metalorganic chemical vapour phase epitaxy) in different conditions of temperaturę, pressure and reactants flows. Then, the layers will be characterized using optical, electronmicroscopic and X-ray diffraction methods.

All examinations results will be used to create self-consistent model of the InGaN microstructure. The success of such approach should: i) enable us to verify if the Holy's theory is useful for an analysis of the X-ray data in the case of InGaN, ii) give us a number of new information how fluctuation of indium in InGaN depends on the growth parameters.

The results of the research planned should be useful not only for nitride-semiconductor community, but also for those who examine the crystals of a high defect density.