The research project aims the elucidation of the mechanisms of threading dislocation introduction into epitaxial heterostructures of nitride semiconductors, *i*.e. gallium nitride and its alloys with indium and aluminum. Presence of dislocations in such structures adversely affect the usefulness for these material for use in opto-electronic. The defects enhance the nonradiative exciton recombinations and thus contributes to device degradation. This is the most serious problem impacting the crystalline quality of these very important materials and the one that has plagued them since their first introduction almost twenty years ago. There are some technological ways for the reduction of the number of threading dislocations in the epitaxial layers, however there is still lack of understanding how such defects are introduced. However, a recent important discovery of the proposers concerning the correlation between the faults in the stacking sequence of subsequent atomic layers and threading dislocation introduction may lead to the elucidation how the threading dislocations may be introduced in the nitride epitaxial systems.

The discovered mechanism is based on the reactions between the partial dislocations terminating the basal stacking faults leading to the formation of threading dislocation loop. We observe that introduction of the one stacking fault enhances the chance for the introduction of the subsequent stacking fault in order to minimize crystal lattice disorder. Depending on the number of the atomic layer inserted prior the formation of the next stacking fault, the stacking fault domain which is formed may create various defect configurations. In some of them, we observe that it may be a starting point to a threading dislocation loop.

In this project we want to study various stacking fault domains configurations and check how they may work as a source for threading dislocations. In order to do it we will use transmission electron microscopy to visualize the defects. The high resolution transmission electron microscopy images of the defects will be used for the computer simulation of the defect configurations. The latter will be followed by the large scale defect simulation in order to assess their energy and probability of occurrence. We will also correlate the mechanisms of these defect introduction with the conditions of the epitaxial growth of nitride epitaxial layers.