Nitride semiconductors, i.e. gallium nitride (GaN), indium nitride (InN), aluminum nitride (AlN), and their AlInGaN alloys, are a group of materials well-known for their applications in electronic and optoelectronic devices. Most of nitride-based structures is built on foreign substrates (sapphire, silicon, silicon carbide) covered with a thin (few hundred nanometers to a few micrometers) layer of nitride. Such substrates are called templates. Currently, there is a focus on replacing the foreign substrates with GaN ones. This is especially mentioned in terms of high-power vertically operating transistors. Due to their design, such devices should be built on a native nitride foundation of very high structural quality. **Poland is one of the leaders in high-quality bulk GaN.** First GaN single crystals with low threading dislocation density were presented in the 1990s. They were grown in high pressure and high temperature from solution of atomic nitrogen in liquid gallium (high nitrogen pressure solution, HNPS) at the Institute of High Pressure Physics Polish Academy of Sciences (IHPP PAS). In the first decade of the 21st century a Polish company Ammono introduced their GaN wafers into the market. The material, crystallized by ammonothermal method, was of exceptionally high structural quality. In the same time IHPP PAS developed, besides the HNPS growth, crystallization from gas phase, hydride vapor phase epitaxy (HVPE) method. Combination of ammonothermal and HVPE methods resulted in HVPE-GaN of extremely high structural quality and high purity. Synergy of advantages of these two approaches to crystallization created new and attractive possibilities for an effective production of GaN crystals**. It was also noticed that HVPE method can be used not only for growth of bulk GaN. Thin (up to 200 μm) layers can also be deposited.** Such layers, n-type with a low free carrier concentration and of high purity, can be grown on highly conductive n-type GaN substrates. This way a basic structure of vertically operating transistor is created. An important parameter of these devices, namely breakdown voltage, depends on the thickness of the deposited n-type layer. **HVPE, therefore, becomes the main method for obtaining such layers.** Growth rate in HVPE reaches 100 μm/h which is a much higher value than in case of MOCVD (metalorganic vapor phase epitaxy) or MBE (molecular beam epitaxy). Generally, thickness of GaN layers grown by MOCVD or MBE does not exceed 10-15 μm. **High-purity and up to 200 μm thick GaN of high structural quality can only be deposited with the use of HVPE. This technology seems to be crucial for preparing part of a structure, namely the drift layer, for devices with breakdown voltage of a few or several kV.** Drift layers have a semi-insulating region on the surface or regions with p-type conductivity (with hole instead of electron conductivity). P-type GaN can be obtained by different acceptor (e.g. magnesium) implantation into the GaN layer. However, implantation process leads to damaging the crystallographic structure of implanted material. Such damage can be removed by proper high-temperature annealing of the layers. **The main goal of this project is to investigate implantation of acceptors like magnesium (Mg), beryllium (Be), or zinc (Zn), as well as co-implantation with nitrogen (N) into thin (10 - 100 μm) unintentionally doped layers of gallium nitride (GaN) crystallized by hydride vapor phase epitaxy (HVPE) method on native seeds.** The grown material should be of high purity, with free carrier (electron) concentration below 5×10^{16} cm^{-3}, and of high structural quality. Parameters of implantation process should result in obtaining a few hundred nanometers thick layer with concentration of implanted acceptors at the level of 10^{19} cm^{-3}. **The first goal of the project is to determine basic parameters of HVPE-GaN growth processes (reagent flows, growth temperature) as well as parameters of ion implantation, including co-implantation with nitrogen.** Post-implantation damage will be removed by high-temperature (1400-1480°C) annealing at high nitrogen pressure (1 GPa). **One of the goals of this project is to investigate basic structural, optical, and electrical parameters of implanted and annealed GaN layers. Obtaining p-type regions on the surface will be a measurable success.** Nitrogen incorporation into acceptor-implanted layer should prevent the creation of nitrogen vacancies. These defects act as donors in GaN and they are created in p-type material (when acceptors are incorporated into GaN). Presence of nitrogen vacancies can, therefore, lead to compensation of acceptors and hinder the desired p-type conductivity in the implanted layers.