The term “elastic–plastic transition” refers to the phenomenon that breaks a reversible path of the elastic deformation, switching a material into plastic state. Interestingly, the elastic-plastic transition is often explained by nucleation of dislocations which has been proved not only for metals and their nano-objects, but also for GaN and SiC semiconductors.

The case of semiconductor crystals is more complex as understanding of their nanoscale plasticity requires consideration of phase transformations. Silicon provides an example that the course of deformation induced by a sharp indenter depends on transformations to high-pressure phases. Similarly, the nanoindentation-induced plasticity of GaAs crystal is initiated by the phase transformation from GaAs-I to metallic GaAs-II structure. In contrast to bulk semiconductors, the plastic deformation of their small-scale objects can proceed without participation of phase transformations.

Peculiarities of plastic deformation of dislocation-free Si and GaAs crystals elicit questions about the phenomenon responsible for elastic-plastic transition of other widely used semiconductors. One of such materials is indium phosphide (InP) used for the construction of optically active nanoelectromechanical systems, field-effect transistors, photodetectors, light emitting diodes, waveguides, and solar cells. Taking into account the above-presented discussion, the main goal of this proposal is to verify the following hypothesis: *the plastic deformation of a dislocation-free InP crystal is initiated by the transformation from the semiconducting B3 structure to the metallic phase of the B1 structure*.

The presented research idea has a basic character. It offers a solution of the original and controversial problem of InP incipient plasticity. The subject of this project is strictly related to the scientific activity that determines the development of nanotechnology, which knowledge of physical phenomena occurring in the localized stress fields is important. In a greater detail, the impact of a future findings on design and production of semiconductor nanostructures is expected. Thus, it can be assumed that scientific achievements of this project will be of interest to scientific circles and readily accepted by the industrial community as well.