The project “Epitaxial low-dimensional heterostructures made of 2D and 3D chalcogenides.” is devoted to optical investigations of electronic states in novel nanostructures. Nanostructures will be prepared using advanced crystal growth technique - molecular beam epitaxy (MBE).

Two-dimensional (2D) materials used for fabrication of nanostructures, transition metal dichalcogenides, will be composed of atoms such as tungsten or molybdenum (transition metals) combined with selenium, tellurium or sulphur (group VI elements). For such materials, the most interesting optical properties are expected for a monolayer thickness, what means e.g. one atomic layer of selenium, one atomic layer of molybdenum, and one atomic layer of selenium. So far mechanical exfoliation of monolayers from bulk crystal was used to prepare such materials with high optical quality. We propose that optical nanostructures within plane of monolayer should be rather grown than mechanically prepared. Realization of the project will possible thanks to recent technological breakthrough in growth of transition metal dichalcogenides with very high optical quality. This breakthrough has been achieved last months by head of the project, in laboratories where the project will be realized.

Three-dimensional (3D) materials used to build nanostructures will be classic chalcogenides, grown in MBE for a long time, eg ZnSe (zinc selenide). These materials tend to form nanostructures, e.g. quantum dots, which result in excellent optical properties under appropriate growth conditions, such as e.g. in MBE.

The combination of 2D and 3D chalcogenides will allow us to study the interaction of nanostructures and materials of various dimensionalities.