Isotactic polypropylene is a polymer produced and used on a large scale. It is a semicrystalline polymer, which usually crystallizes in the crystallographic monoclinic alpha form. High pressure, especially 200 MPa or higher, favors crystallization of this polymer in the crystallographic orthorhombic gamma form. The gamma form has a unique structure because of the non-parallel arrangement of the polymer chains in the crystal. Polypropylene in the gamma form can exhibit better mechanical properties than polypropylene in the alpha form; the elastic modulus almost two times higher and markedly higher yield strength. Hence materials based on isotactic polypropylene in the gamma form could be used as engineering plastics. Furthermore, the modification of the properties of polymers can be achieved by addition of nanofillers.

In the project it is planned to combine filling of isotactic polypropylene with nanoparticles and high pressure crystallization to obtain novel nanocomposites. Achieving this goal will require production of nanocomposites, their crystallization under high pressure in the specially designed cell, and also during high pressure injection molding. In the latter case, also very important is the flow of molten polymer, inducing the orientation of the macromolecules, which strongly influences the crystallization and structure. The development of injection molding technology allows to achieve high pressure in a mold cavity.

In the project the crystallization of nanocomposites, their structure and properties, and the mechanisms responsible for their mechanical properties will be investigated. Techniques such as electron microscopy, calorimetry, X-ray scattering methods, and mechanical properties testing methods will be used in the study.

The planned studies will allow to obtain novel nanocomposite materials. Knowledge of nanocomposite materials, their crystallization under high pressure and the resulting structure, mechanical properties, and mechanisms responsible for them, will be broadened. We expect that the results obtained will provide in the future a basis for a new class of materials produced on an industrial scale.