When Mr. Robinson, in "The Graduate", a 1967 movie directed by Mike Nichols, asked the theme graduate, Benjamin Braddock (Dustin Hoffman) what has future, the answer was as follow: "One word: Plastics. There's a great future in plastics". And the words came true since it is very difficult to find a field, in which the polymers and so ordinary plastics were not applied. A wide range of products are being manufactured from plastics, from relatively simple items accompanying people in their everyday lives to technically advanced with specialized applications. A very important group of polymers are semicrystalline polymers, the annual production of which amounts to hundreds of millions of tones and it increases significantly each year. Semicrystalline polymers are in fact nanocomposites, in which the lamellar crystals are separated with nanometre thick amorphous layers. Current knowledge related to the structure and the influence of amorphous phase on macroscopic properties of semicrystalline polymers is limited. Such situation seems unacceptable, especially that in the case of crystallizing polymers the content of the amorphous phase, depending on the way of solidification process, may amount from 10 up to 100 wt%. Significantly poorer knowledge of the role of the amorphous phase in the properties of semicrystalline polymers is a consequence of its complex and irregular structure but also a lack of proper experimental techniques that would allow a direct analysis of properties of non-crystalline regions. Therefore, three main objectives of this project have been proposed in relation to the structure and properties of the amorphous phase and the influence of this component on macroscopic properties of crystallizing polymers: (I) it is planned to **create a universal method**, not requiring access to any advanced experimental techniques, that would enable **to determine the tensile modulus of interlamellar amorphous phase and determine the value of this parameter for selected semicrystalline polymers with different properties and microstructure.** The realization of this objective will allow to determine the value of the modulus of interlamellar amorphous phase, what in turn will allow to specify the actual role of non-crystalline component in the mechanical properties of semicrystalline polymers. It will help to predict the mechanical properties of a polymer with given microstructure (with known content of amorphous and crystalline component) and also to design materials with desired mechanical properties. The mechanical parameters specified as the result of implementing this project will allow to significantly increase the accuracy of studies (particularly those based on micromechanical modeling), which require including the actual values of the modulus of interlamellar amorphous phase; (II) it is planned to conduct complex studies related to the **influence of the structure of amorphous phase on the barrier properties of semicrystalline polymers (with particular focus on the role of the free volume)**. Additionally, it is planned **to propose a method enabling an effective and permanent modification of non-crystalline regions leading to an improvement of molecular packing of the amorphous phase and**, as a consequence, **a significant improvement of barrier properties** (without any significant change of the other physicochemical properties). The results obtained in the process of realization of this task will allow a better understanding of the role of the amorphous phase in the barrier properties of semicrystalline polymers; (III) it is planned to **adapt of one of the currently available experimental techniques in a way that would enable tracking the changes of the structure of amorphous phase (with particular focus on the role of the free volume) resulting in generation of cavitation pores and performing such analysis for selected semicrystalline polymers with different properties and microstructure.** The realization of the studies planned within this objective will allow a better understanding the mechanism of initiating the cavitation pores during deformation of semicrystalline polymers. This in turn will facilitate preparing a real and coherent description of the process of plastic deformation of such materials, with the consideration of the presence of cavitation phenomenon. Knowing the actual mechanism of initiating the cavitation phenomenon, particularly in relation to the free volume of the amorphous phase, will have a very important meaning in terms of application, it will allow controlling the intensity of the cavitation phenomenon in a desirable way, by the user of a given cavitating semicrystalline polymer.

The above presented objectives (related to the structure and properties of the amorphous phase and its influence on macroscopic properties of crystallizing polymers) have been identified based on detailed analysis of literature data and on the potential influence of the results obtained as an effect of the accomplishment of the project on the development of widely understood materials engineering.