DESCRIPTION FOR THE GENERAL PUBLIC (IN ENGLISH)

(State the objective of the project, describe the research to be carried out, and present reasons for choosing the research topic - max. 1 standard type-written page)

The project „*The self-assembly of superstructures of peptidic nanofibrils controlled by conformational memory effect*" is aimed at deepening the current understanding of the intriguing capacity revealed by many proteins and peptides (including insulin) to form highly-ordered microscopic structures built of so-called amyloid fibrils. Such nanofibrils constitute a peculiar category of „polymerized" proteins.

Depending of the kind of protein from which amyloid fibrils are formed, the presence of such entities in an organism can be symptomatic of severe neurodegenerative disorder (e.g. Alzheimer's disease or Parkinson's disease), or on the contrary: be necessary for the proper biological function. That stems from the unusual stability and durability of amyloid fibrils. These amyloid traits have been utilized by bacteria forming biofilms which allow these microorganisms to survive at various interfaces. Also higher organisms took advantage of properties of amyloid fibrils, as is the case of biosynthesis of melanin in pigmented skin cells. The extraordinary among proteins properties of amyloid fibrils have attracted attention of chemists, biophysicists and experts from the field of material science interested in using amyloid to create novel biologically-inspired materials and molecular devices. Our project is targeting one of the fundamental problems hampering development of amyloid-based nanomaterials.

Conversion of „normal" i.e. correctly folded and biologically-functional (in other words 'native') protein into its polymerized form (amyloid) is very complex. This complexity has, in a way, a two-dimensional character: it arises not only from many sequential stages, but also from the existence of parallel transition pathways leading to slightly different types of amyloid (each built from the same protein). Ultimately, a spontaneous transition of native protein into amyloid results in a structural heterogeneity of fibrils. It is this heterogeneity which often prevents applications of amyloid fibrils as building blocks for novel materials and molecular devices.

Our project is based upon harnessing so-called *conformational memory effect* allowing one to program structure of fibril with an amyloid „seed" whose structure is replicated with a high fidelity by a growing nanofibril. In our previous studies, we have discovered a fascinating variant of insulin amyloid named *+ICD / -ICD* with many potential applications in nanotechnology. The main objective of „*The self-assembly of superstructures of peptidic nanofibrils controlled by conformational memory effect*" project is to carry out a thorough study of the nature of transition pathways leading from the native insulin to +ICD / -ICD structures so that, with the help of conformational memory effect programmable, well-defined amyloid fibrils could be accessed and synthetized.

Achieving this goal will facilitate development of novel unique amyloid-based nanodevices (e.g. biosensors) for applications (among others) in biotechnology and clinical diagnostics.