DESCRIPTION FOR THE GENERAL PUBLIC

The natural, uniform macromolecules such as proteins and DNA of perfectly, sequence-defined structures have been inspiring polymer chemists for years. They are components of natural matter, that creates living objects able to move, work and even think. The roles and functions they can attain are determined by their three-dimensional arrangement that depends on monomer sequence. In spite of many efforts, man-made materials are still far away from functions that are displayed by natural matter. To reach for the diverse structures and complex properties achieved by native biological polymers sequence programmability of the synthetic polymer is required.

OBJECTIVE

This project aims to investigate the synthesis and structural properties of sequence-defined synthetic polymers – polyurethanes (PUs). The ***general objective in this project is to gain control over the three-dimensional structure of PUs by monomer sequence evolution***, as it is observed for natural proteins formed from sequences of amino acids (Fig. 1).

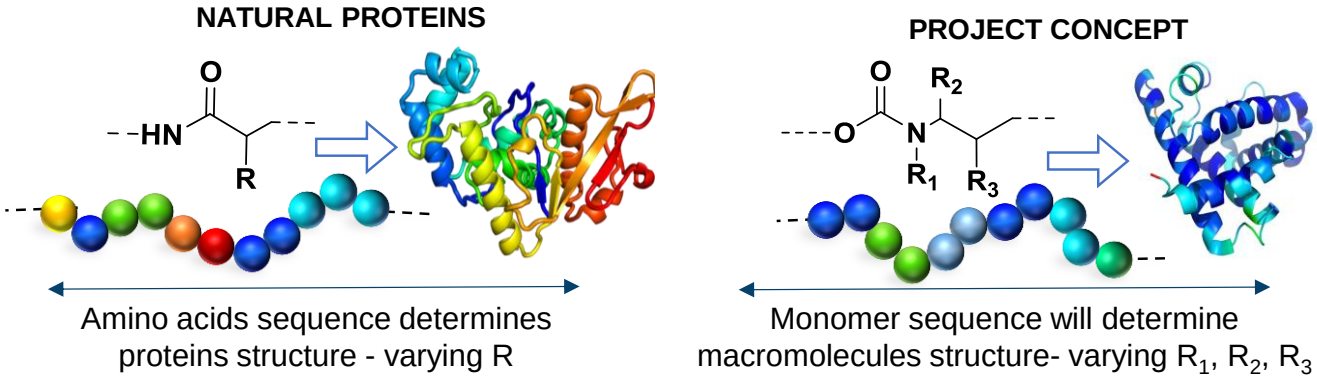

Figure 1. *Comparison of (a) proteins and (b) polyurethanes structures. The aim of this project is to synthesize sequence-defined macromolecules that will fold into well-defined three-dimensional structures - similarly as it is observed for natural proteins, and this folding will be controlled by monomers sequence and their chirality.*

RESEARCH PLAN

To reach the project's goal three research tasks will be implemented: (1) ***Development of efficient synthesis method yielding sequence-ordered polyurethanes of defined chirality***; (2) ***Work out the methodology to study three-dimensional structures of resulting macromolecules***; (3) ***Study of sequence-structure relationships by the evolution of monomer sequence and their chirality***.

JUSTIFICATION

The challenge of creating synthetic materials with the structural sophistication and complex functions found in biology has been a long-term goal in materials science. Polymer sequence control is required for complex properties that are achieved by native biological polymers. ***This project will add a fundamental knowledge of synthesis and structural properties of synthetic sequence-defined polymers*** to fill a part of the large gap between synthetic polymers and native biological materials. The ***understanding of sequence-structure relationships*** will enable to gain better ***control over polymers properties and will advance their application*** scope. Such polymers can find future use in sophisticated materials e.g. functional coatings for detection of (bio)molecules; surface coating for controlled cell culture and harvesting; separation of enantiomers of natural products and synthetic drugs that are critical in a wide variety of biomedical applications; drug discovery platforms protein-mimetic materials.