DESCRIPTION FOR THE GENERAL PUBLIC

The aim of this project is to investigate how the supramolecular structure affects functional properties, such as barrier properties and mechanical properties of new polymeric materials, copoly(amide-esters), partially or fully based on the renewable resources. Macromolecules are differently located in the material they build, i.e. they form a different supramolecular structure. If the macromolecules are flexible in the conditions of the supramolecular structure formation, then in order to achieve the minimum surface energy, they will concentrate into the globules (Fig. 1). **The studies on the supramolecular structure of (co)polymers received a remarkable interest of numerous research groups, especially in the field of materials science and engineering.** Examining how a newly created supramolecular structure, with varying heating/cooling and operational conditions, influences the mechanical and barrier properties of copolymers, especially those based on 2,5-furandicarboxylic acid (FDCA) derivatives, which was named one of the twelve most promising compounds of plant origin for the synthesis of polymeric materials, including polyurethanes, polyamides and polyesters as well as their copolymers with elastomeric properties, testify to the remarkable significance of the research subject in the project.

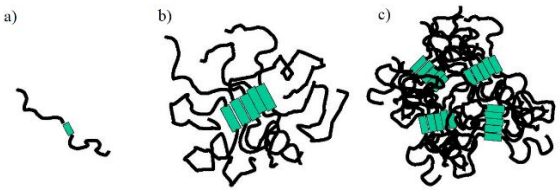

Fig. 1 Schematic presentation of the polymer structure: a) block polymer, b) supramolecular unit, c) bulk structure [1]

The obtained materials will be subjected to a series of tests to establish the mutual correlation between the supramolecular structure and functional properties of these materials. In the first step one will synthesize and characterize the oligoamides, which subsequently will be used to obtain copolymers containing ester and/or ether blocks. Next, the chemical structure of synthesized copolymers will be confirmed using nuclear magnetic resonance spectroscopy (^{1}H NMR, ^{13}C NMR), Fourier-transform infrared spectroscopy (FTIR), size-exclusion chromatography (SEC) and the viscosity measurements (intrinsic viscosity number measurements). Consequentely, using differential scanning calorimetry (DSC), dynamic mechanical thermal analysis (DMTA) along with X-ray diffraction (XRD), atomic force microscopy (AFM) positron annihilation spectroscopy (PAS) one will examine the structure of the copolymers as a result of their miscibility or non-miscibilty of individual blocks forming the copolymer, resulting from their different chemical structure and possible interactions between them. In addition, the molecular mobility, resulting from the structure of the macromolecules will be evaluated, using dielectric spectroscopy in the frequency range of 10^{-1}-10^{6}Hz, and temperature range of -150-150^{o}C, in order to thoroughly examine the phenomena occurring in the sample depending on the frequency and temperature. As a result of the obtained research results, conclusions about the influence of the supramolecular structure on the barrier and mechanical properties of the obtained materials can be formulated.

The main reason for undertaking the research topic of this project are the decreasing resources of mine fuels, fluctuating oil prices, significant emission of greenhouse gases and limited biodegradability of materials obtained from raw materials of petrochemical origin, which entails searching for renewable raw materials for their production. Each year, it is produced and marketed millions of tons of plastic packaging used for food packaging and technical products. Renewable resources offer a wide range of chemical compounds that can replace existing monomers or open up possibilities for the synthesis of new materials. Obtaining and testing of functional properties, precisely barrier and mechanical properties, depending on the structure, new copolymers containing ester, amide and / or ether blocks with the use of renewable raw materials, especially raw materials of vegetable origin (maize and other plant products) is the answer to the search for environment and ecology friendly solutions.

1. Zhang, Y.; Chung, I. S.; Huang, J.; Matyjaszewski, K.; Pakula, T. Macromolecular Chemistry and Physics ***2005***, 206, *33-42*