DESCRIPTION FOR THE GENERAL PUBLIC

The last decade is characterized by extremely dynamic and substantial development of nanotechnology, and hence also of nanomaterials. Their size generally does not exceed 100 nm. The synthesis, or obtaining and characterization this type of particles is currently the subject of many studies. Because of their specific properties, among which we can distinguish small size and non-toxicity of these materials, they exhibit different properties compared to their counterparts in the macro scale. Nanocrystalline polysaccharides are special class of materials, which derived from natural sources. Native polysaccharides usually consist of crystalline and amorphous regions, while the nanocrystalline polysaccharides are obtained by removing amorphous regions by the acidic hydrolysis. The compounds are characterized by additionally properties such as biocompatibility, biodegradability, low production cost, and wide availability in nature. The above mentioned properties make nanocrystalline polysaccharides found widespread application in materials chemistry.

The natural polysaccharides are biopolymers which occur in living organisms and are widely used. The ideal source for obtaining the polysaccharides are fruits (pectin), vegetables (starch), and paper (cellulose). These materials can also constitute plant waste and paper waste. According to the Central Statistical Office, the amount of waste collected separately in the years 2005-2014 in Poland is increasing (2005 - 245kg/person; 2014 - 268kg/person), what adversely affects the environment. Use of waste generated would lead to the reduction of garbage and their proper management. Polysaccharides such as starch, cellulose, and pectin are appropriately modified. Polysaccharides having a reactive dialdehyde group are increasingly used as cross-linking agents in tissue engineering (designing implants), pharmacy (immobilization of enzymes), or food (for preparation of films for food packaging). The cross-linking of materials improves their physical, chemical, and mechanical properties. The cross-linking process is the reaction of the functional groups of the polymer with functional groups of the cross-linking agents. This allows forming of covalent bonds which favorably affect the properties of the material obtained. In contrast to the commonly used glutaraldehyde and epichlorohydrin, polysaccharides containing aldehyde groups do not induce the cytotoxicity effect. The basis for the assertion that the resulting nanocrystalline cross-linking agents have a beneficial effect on the effective cross-linking process of biopolymer coatings is the fact, that they have reactive aldehyde groups and amino groups which can react with functional groups of the biopolymer to form a covalent bond. In the literature, the absence of any reports regarding the synthesis of materials, which are cross-linking agents. They are also characterized by nano-scale size, contained in structure polysaccharides of natural origin, and have been isolated from plant waste and paper waste.

The goal of the project is design, synthesis, and characterization of a new class of non-toxic nanocrystalline cross-linking agents containing aldehyde groups and amino groups, which are obtained from plant waste and paper waste. Obtaining active, non-toxic, nanocrystalline cross-linking agents would allow the use of these materials in many areas of science, for example in tissue engineering for cross-linking hydrogels for the manufacture of implants, in pharmacy for the immobilization bioligands, and food industry for cross-linking polymeric films for food.

The project relies on the interplay between nanotechnology with synthesis of nanocrystalline cross-linking agents containing reactive aldehyde groups and amine groups, with simultaneous development of effective methods of obtaining polysaccharides from plant waste and paper waste. It can lead to significant development of medical science, pharmaceutical, and food industries, also management defaulting tons of paper waste and plant waste.