

The unique physicochemical properties of porous materials, decide about their undying interest in many fields of science. Their special properties are associated mainly with their structures - porous structure (number, shape, and size of the pores). The main objective of this project are multidisciplinary research that focus on synthesis of resins and oligomers, and then receiving of them **porous nanocomposites - hydrogels and aerogels** (also called "hydro-sponge-like" and "aero-sponge-like"), containing **carbon nano-onions**. The aim of the project will also be a full physicochemical characterization of synthesized materials, taking into account their key features: the ability to store electric charge and the possibility of their application in electrocatalysis. The development of methods for the synthesis of hydrogels and aerogels, will create a group of versatile porous materials based on the same precursors. Due to multi-functionality and promising properties, they may have a variety of potential applications, including fuel cells, capacitors and dielectric elastomers, electrochemical sensors and sensor to immobilize enzymes or biologically active compounds (biosensors).

Despite the many literature reports it appears that the potential of hydrogels and aerogels has not yet been fully exploited so far, especially considering their electric and electrochemical potential. In the light of the growing interest in the physicochemical properties and the potential of porous materials, the studies of hydrogels and aerogels with unusual and controlled physicochemical properties are still required. Limitations associated with application of this group of compounds in the materials chemistry and engineering, are mainly due to the problems associated with the formation of porous structure and low mechanical stability of these materials. In view of the above, it seems that the looking for new materials in this group of compounds, requires still continue basic research. In the project it is proposed the use of porous materials in the areas where it is necessary to search of the materials with an expanded active surface, extremely high porosity, mainly related to the presence of the micro- and macropores, low thermal conductivity and high dielectric permittivity. All of these above listed properties, can be hydrogels and aerogels, which obtaining is planned within the framework of this proposal.

The concept of multidisciplinary research and the application of the same aerogels as electrode materials in capacitors and electrocatalysis **is a new concept**. Synthesis of new materials and the development of methods for the synthesis of hydrogels and aerogels, will create a new group of porous versatile materials, based on the same precursors. Such an approach, based on the multi-functionality, in one group of compounds is non-standard. Minor changes in chemical structure of precursors or experimental conditions during their synthesis, can lead to changes in physicochemical properties of obtained products. Research will be carried out many directions, taking into account the various aspects that should meet the obtained materials. Such an approach will enable the development of new procedures for receiving materials with controlled porosity and "targeted" physicochemical properties.