DESCRIPTION FOR THE GENERAL PUBLIC (IN ENGLISH)

Carbon aerogels are a special class of nanostructured materials with a very low density, unique structure and functional properties, which make them desirable materials for a wide range of technological applications. These materials have been known for about 25 years and had been prepared for the first time by the American scientist Richard W. Pekala and his colleagues at Lawrence Livermore National Laboratory. Generally, carbon aerogels are formed from the sol-gel polymerization of resorcinol and formaldehyde, followed by supercritical drying, and subsequent pyrolysis at an elevated temperature in an inert atmosphere. Though, the use of natural polysaccharides and their derivatives is considered to be more appealing owing to their abundance, availability, renewability, stability, non toxicity and low cost.

The following project reports carbogel materials derived from natural polymers (starch, cellulose of different botanical origin) excluding the expensive and time-consuming drying process. The main aim of considered studies relates to a fundamental and comprehensive research carried out in order to gain knowledge about the mechanism of nanostructured carbon materials formation that will be obtained from cheap, abundant and renewable precursors. The correlation between the chemical composition of the carbogel precursor, key parameters of the preparation process as well as the electrochemical properties of the resulting carbon materials will be examined.

Optimal conditions for the preparation and pyrolysis processes of the carbogel precursors will be investigated by thermal analysis techniques (TGA/DTG/SDTA/EGA-QMS and DSC). Obtained materials will be also characterized in terms of structure and surface morphology using X-ray powder diffraction (XRD), Raman spectroscopy (RS) and low-temperature nitrogen adsorption-desorption measurements (N_2-BET). Electrical properties of carbogel materials will be determined further by the electrical conductivity studies (EC) using 4-probe method in the range of room temperatures. At the end, for a representative group of samples the electrochemical characteristics of lithium cells will be determined by charge/discharge cycling tests (CELL TEST), electrochemical impedance spectroscopy (EIS) and cyclic voltammetry (CV).

The provided results will allow the determination of the optimal conditions for preparation process of new, nanostructured carbogel materials with tailored properties. Obtaining of structurally and chemically stable carbogel system that indicates good electrochemical characteristics may contribute to the improvement of the energy, economic and ecological aspects of energy storage (inter alia in lithium batteries, supercapacitors).