Carbogels prepared from starch as new high performance anode materials for lithium-ion batteries

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Graphite is the most often commercially used anode material in lithium-ion batteries (LIBs) [1]. However, due to the depletion of non-renewable resources of this compound various types of carbonaceous materials have been investigated. The search for low-cost and high-capacity carbon anodes made from easily accessible raw materials is nowadays a crucial issue for high performance energy storage systems. For this reason, investigations have been focused on bio-derived carbon materials for the sake of high specific capacity, controlled microstructure and morphology. The precursor sources and pyrolysis condition determine features of green carbon materials [2]. The promising precursor is starch - renewable, low-cost and attractive for energy storage systems. In this work we present carbon anode materials derived from diverse types of starch. Main goal of this research was: how the origin of starch influence on physicochemical and electrochemical properties of new carbogel materials [3-4].

Carbon materials were obtained after direct pyrolysis of organic precursors derived from different types of starch (maize MS, potato PS and rice RS). At the first step, raw materials were dispersed in water (10% w/v), placed in a water bath, stirred and heated up to the gelatinization temperature. The starch suspension was removed from water bath, then water was exchanged into ethanol in during few days process. The last step was pyrolysis at different temperatures (700°C and 900°C) to obtain carbogel active anode materials (CBG). The effect of the carbon sources on the structure, morphology and electrochemical properties of obtained anode materials were investigated. The chemical composition, microstructure and porosity of the samples were characterized by elemental analysis (EA), powder X-ray diffraction (XRD), scanning electron microscopy (SEM), Raman spectroscopy measurements and low-temperature nitrogen sorption method (N_2-BET). The electrical properties of the carbons were determined by an *ac* 4-probe method. To investigate the electrochemical performance of the carbon electrodes Li/Li^+/(CBG) cells were used. The galvanostatic charge-discharge tests (GCDT), cyclic voltammetry (CV) and electrochemical impedance spectroscopy (EIS) were performed on R2032 type coin cells.

Six different varieties of porous carbogel materials were prepared. Proposed technology may find an application in obtaining anode materials for lithium-ion batteries. The synthesized materials have a hierarchically porous carbon microstructure with a large surface area and good electronic conductivity. According to great electrochemical performance proposed carbogel active anode materials are considered to be ideal frameworks for electrochemical energy storage.

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