Description for the general public

The dynamic market growth of portable electronic devices (laptops, smartphones, cameras, etc.) forces the development of new efficient power sources. The user expects long life and high gravimetric and volumetric energy density batteries. Since the first commercialization by Sony in 1991, lithium-ion batteries have become a prominent power source for electronic devices. Lithium-ion batteries now supply the electric and hybrid vehicles. The widespread use of lithium-ion batteries in electric vehicles requires new design solutions providing higher energy density, ability to work under high current and at low temperatures and a higher level of security. In the case of hybrid and electric cars lithium-ion battery weighing 200 kg with an energy density of 140 Wh/kg allows you to drive 150 km on a single charge. If we want to achieve 500 km range with a single charge of the battery we need to develop technology with an energy density exceeding 500 Wh/kg.

Lithium-sulfur batteries are considered the most promising chemical power source that meets these requirements. The Li-S battery uses lithium metal as the anode and elemental sulfur as a cathode. The development of a fully functional Li-S battery is a complex challenge to research and technology, and requires simultaneous optimization of a number of important parameters. At present, many problems remain unresolved, despite intense efforts and the work carried out around the world.

The main objective of the project is to obtain the porous carbon materials with developed specific surface area and their use as an additive to the sulfur cathode. The activated carbons will be prepared waste materials such as lignite, plum stones, corn on the cob, fruit skins linking environmental aspects with significant improvement in working parameters of lithium-sulfur batteries. One of the task of the work will be a novel approach to electrochemical research and an attempt to construct a sealed glass cell in the shape of a cuboid. Transparent vessel wall will allow observation of electrolyte color changes and in-situ study of lithium polysulfides formation during cycling. We hope to gain valuable information about the kinetics of electrode reactions taking place in lithium-sulfur cell and assess the impact of porous carbon addition to the cathode on the lithium polysulfides migration.