

Title of the project: Novel sulfur-tuned advanced carbons: synthesis, characterization and applications

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Summary:

The current times make us all more and more aware of the importance of access to the key resources of the 21st century: energy and a clean environment. On the one hand, the development of modern civilization requires increasing access to various energy sources, and on the other, it destroys available natural resources and pollutes the natural environment. The need for effective energy storage has led to the development of lithium-ion batteries - the most advanced energy storage devices today, which are extremely popular due to their reliability and long operating time. However, there is a dark side to the widespread use of lithium-ion batteries: extracting the various metals needed to produce these batteries requires the use of huge amounts of natural resources. Additionally, these batteries can be dangerous, exploding or catching fire if damaged or misused. So is there any alternative?

Aluminum-sulfur batteries may constitute one of the greatest technological breakthroughs in the field of electric mobility - they are particularly interesting because, unlike lithium-ion batteries, aluminum-sulfur batteries do not require valuable and rare materials - aluminum and sulfur are safe, widely available and cheap to mine. Unfortunately, there is no rose without a thorn - their disadvantage is the short battery life, due to the specific and irreversible reactions that one of the key components of these batteries undergoes - sulfur

The aim of this project is to design, obtain and test specially designed materials in which sulfur is pressed into the pores of another, commonly available material - carbon (or more precisely, its porous form called activated carbon), in such a way that such material can be successfully used in aluminum-sulfur batteries, with better properties than those currently available. The project manager - during his stay in the USA in 2023, together with scientists from the USA and Japan, showed that it is possible to obtain such materials, called sulfur-tuned advanced carbons (abbreviated STACs)

This project is devoted to the further development of this new class of materials, including examining the impact of synthesis conditions on the final properties, as well as testing them as electron materials in aluminum-sulfur batteries, but also as photoactive materials that could be ultimately used in air purification processes. The knowledge obtained through the implementation of the project will be a step forward towards the development of new, better sources of energy storage as well as materials capable of effectively purifying the air.