

Construction of new carbon nanomaterials and their targeted functionalization are important directions of development in nanotechnology and materials science. The discovery of fullerenes in 1985 and the isolation of single graphene layer in 2004 were milestones in the development in this field, awarded the Nobel prizes in the fields of chemistry and physics, respectively. Both of these nanostructured forms of carbon are characterized by a range of unique features, which entailed a number of promising applications in electronics, photovoltaics, optics, materials science and medicine.

In the framework of this research project integration of functionalized graphene and appropriately selected fullerenes or their derivatives is planned in order to obtain materials for energy storage in an electrochemical capacitors, also known as a supercapacitors or ultracapacitors. The main advantages of this type of devices include high capacitance and short times of charging / discharging. In the project we will test a series of fullerene derivatives, which allow to determine the impact of structural factors on the parameters of the resulting system. Comprehensive spectroscopic studies using reflection-absorption infrared spectroscopy (IRRAS) and X-ray photoelectron spectroscopy (XPS) in combination with a number of microscopic methods, such as scanning tunneling microscopy (STM), atomic force microscopy (AFM) and scanning electron microscopy (SEM) will provide a complete description of the composition and structure of the obtained composite materials. Electrochemical properties of the obtained nanomaterials will be examined by means of cyclic voltammetry (CV), cyclic chronopotentiometry (CC) and electrochemical impedance spectroscopy (EIS). Thermal stability of these nanomaterials will be investigated using thermogravimetry.

New graphene/fullerene nanocomposites should be able to store energy, in particular revealing high capacity and durability. The experimental nature of the project should lead to new paths for obtaining energy storage materials, while giving at the same time answers to a number of fundamental questions related to the construction of those devices at the molecular level.