The dynamic growth of the global population and economy tends to cause an ever-increasing demand for electric energy from the sustainable sources such as solar and wind energies. Most of perspective renewable energy sources suffer from unstable working performance. Therefore, constructing efficient and environmentally friendly, and low-cost devices for energy storage and conversion from the renewable energy sources remains one of the greatest research challenges. Intensive research has been made in the field of electric energy storage and conversion devices, which include batteries and electrochemical capacitors. The electrochemical capacitors, also known as supercapacitors, ideally fit the gap between lithium batteries and conventional electrolytic capacitors as shown in the Ragone plot in Figure 1. Supercapacitors allow to store the energy in the device which is characterized by high power densities, fast charge/discharge capability and cycling stability.

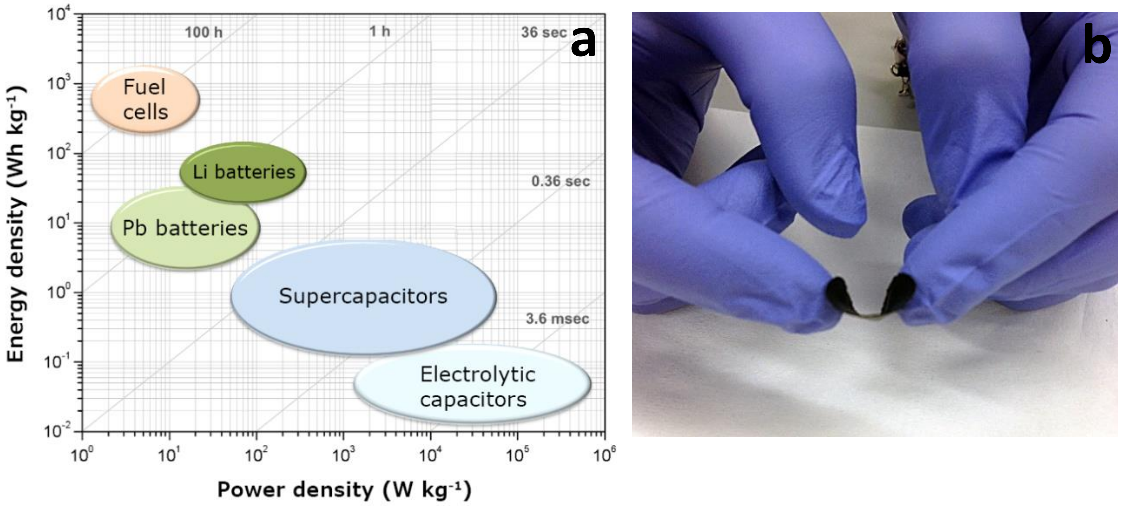

Figure 1. Ragone plot for different energy storage systems (a), flexible supercapacitor electrode (b).

The electrode materials for supercapacitors are divided into three main categories: (i) carbon materials with a developed porous structure; (ii) transition metal oxides and hydroxides; (iii) conductive polymers. Each of aforementioned group is characterized by their advantages and disadvantages. Metal oxides yield high theoretical capacitance values, however, due to their low conductivity these capacitance values cannot be reached. In turn, conductive polymers exhibit high specific capacitance values, but the mechanical degradation of polymer chains results in fast decay of the electrode material, which leads to worsening supercapacitor performance. In the last few years, the idea of the design of novel electrode materials for supercapacitors based on the composites, which combines different material advantages, has emerged.

The aim of the project is to design and to synthesize of the three-dimensional multi-component composites based on conductive polymers (polyaniline, polypyrrole or poly(3,4-ethylenedioxythiophene)), reduced graphene oxide and ferrites (cobalt ferrite and tin ferrite) using a novel approach consisting of two sequential hydrothermal treatments, and their application and evaluation as an active material in a supercapacitor flexible electrode working in an aqueous electrolyte.

The obtained results will allow the assessment and a better understanding of the synergistic interactions between the components in the composites used as a supercapacitor electrode. The outcome of this study will serve to design the composite with tailored electrochemical behavior, including high specific capacitance, low resistance, stable cyclic performance and wide working potential range. Additionally, application of conductive polymer based composites facilitates formation of the flexible supercapacitor electrodes, which can be regarded as the future direction of electrodes development in energy storage devices.