"Let's say you wanted to put a small amount of electrical current into an adhesive bandage for drug release or healing assistance technology. The microsupercapacitor is so thin, you could put it inside the bandage to supply the current. You could also recharge it quickly and use it for a very long time."

Richard Kaner, California NanoSystems Institute at UCLA

Developing technology to store electrical energy so it can be available to meet demand whenever needed would represent a major breakthrough in electricity transferring and distribution in the both large and small scale. Lithium-ion batteries and supercapacitors are particularly important in this field of science and industry. Batteries have a large energy storage capability while electrochemical capacitors (called also as supercapacitors) stand out for their high power, the fast charge-discharge rate, and their excellent cycling life. Electrochemical supercapacitors can replace batteries in electrical energy storage and harvesting applications. Supercapacitors are used in situation where a short peak of high energy is required, such as electric cars, automatic doors, elevators, and many other everyday life applications that involve energy storage. In the recent years, a notable improvement in performance of electrochemical capacitors has been achieved through recent advances in understanding charge storage mechanism and the development of advanced nanostructured materials. Combination of high-capacitive nanoparticles such as organic conducting polymers, with the nanostructured carbon materials has brought the energy density of electrochemical capacitors closer to that of batteries.

The aim of this project is to develop new devices able to store big amount of electrical energy with high power performance. In order to achieve this task, new nanoporous materials for lithium-ion batteries and supercapacitors will be synthesized. Mesoporous carbon materials will be synthesized by carbonization process at mesoporous silica templates. Next, templates will be covered with electroactive materials. The composites of mesoporous carbon and lithium salts of fluoride iron compounds can be used as electroactive materials for lithium-ion batteries. The large material surface allows for the effective lithium doping during the battery discharge and the presence of mesoporous carbon influences the electroactive material conductivity.

The second part of this project will be devoted to the production electrochemical supercapacitors based on the nanoporous materials. In this case, the increase of electroactive material surface will results in much better capacitance performance of the capacitor. It can be expected that produced supercapacitors will exhibit both high power and high energy density.