Development of many areas of technology enforces the need to develop energy storage devices. From these devices are required constantly higher energy densities and power density, it means the amount of current that the device can store and how fast this current can be supply to the powered device. The first parameter is handled easily by lithium-ion batteries, which are characterized by high energy density. In contrast, devices with a very high power density are capacitors with a double electric layer. However, the high values of both parameters are needed simultaneously. Increased activities of scientists and designers from around the world resulted to create lithium-ion supercapacitors. These devices are a hybrid combination of lithium-ion battery with a capacitor. It is a device with optimum values of both parameters and meeting the expectations of the market. The processes of charging / discharging lithium-ion supercapacitors are fast and very dynamic. This causes the impossibility of testing these devices by means of common used impedance measurement, such as Electrochemical Impedance Spectroscopy, which is unsuitable for testing of non-stationary systems.

The aim of this project is to create the appropriate method for the study of dynamic charging/discharging processes of lithium-ion supercapacitors. This method will be based on a Dynamic Electrochemical Impedance Spectroscopy, and will enable testing of very fast and dynamic processes occurring in these types of devices. During the project, processes of charging and discharging of lithium-ion supercapacitors will be studied for different parameters of charging current and for wide range of temperature from - 40 to 60 degrees Celsius with use of modified method. In addition, accelerated lifetime test and self-discharge test will be carried out for tested lithium-ion supercapacitors.

Realization of the above research subject will enable a better understanding of these devices, thus may contribute to the development of new improved lithium-ion supercapacitors and also for optimal usage of existing ones. These devices are one of a basics elemets of electric and hybrid vehicles. Fast development of this field is a key for the development of civilization. This kind of transport is also way to a cleaner environment. Moreover the research community will receive a new method ideal for the study of dynamic and rapid electrochemical processes and tools for testing and monitoring, among others, energy storage devices.