Polymer gels are the subject of intensive investigations due to their wide applicability. They are soft and wet materials that have three dimensional network structures within polymer containing large amount of solvent molecules. The most popular gels are those containing water, called *hydrogels*, which are widely used in medicine and pharmacy.

Recently a lot of attention is paid to ionic liquids, which are solvents consisting entirely of ions (organic salts liquid at ambient temperature). Due to their exceptional properties, like high ionic conductivity electrochemical and thermal stability, non-volatility, excellent solvent properties, they are proposed to be applied in production of many modern devices, e.g. capacitors, solar cells, actuators, sensors, catalytic membranes, etc. However, to be applied in a device, the ionic liquid must be immobilized within a solid organic or inorganic matrix to avoid drawbacks related to shaping and risk of leakage. On the other hand, the matrix should immobilize the ionic liquid but should not interfere with the ionic liquid's properties needed for the device to work. As a results of immobilization of an ionic liquid in a solid matrix we obtain a gel material, which has been termed ***ionogel***.

The ionogels proposed in the project will be based on polymer matrices. Such ionogels hold a special position due to the great ability to tune the physico-mechanical properties of the matrix. One of several ways to obtain ionogels with polymer matrix is an *in situ* process based on the polymerization or crosslinking of monomers dissolved in ionic liquids. Such ionogels are the subject of this project.

The most often used polymer matrices are polyacrylates, however they suffer from the non-uniformity of the polymer network and problems with oxygen inhibition during their formation. The project proposes application of a new matrix type which has not been considered in ionogels up to now: the matrices formed in the **thiol-ene polymerization** (an exceptional method of polymer formation by addition of thiols to unsaturated compounds). The thiol-ene matrices form ideal, homogeneous polymer networks with good mechanical performance, whereas their synthesis is fast and insensitive to oxygen inhibition. Special advantages gives photochemical initiation of the polymerization process (photopolymerization), which enables production of the materials in minutes at ambient temperature.

The aim of the project is to obtain a new class of polymer ionogels produced *in situ* by thiol-ene photopolymerization in ILs, investigation of the chemistry of their formation and determination of their morphology and physicochemical and electrochemical properties.

The combination of unique features of the thiol-ene matrices with the specific properties of ILs (with optional modification with selected additives) allows to obtain a new generation of ionogels with improved properties; we believe that thiol-ene matrices can become an important new direction for the development of ionogel materials.

Preparation of the new type of ionogels needs the basic and advanced knowledge about the kinetics and reaction mechanism of their formation, as well as mechanical, electrochemical (conductivity, electrochemical stability) and structural properties – factors that determine possibility of application of ionogels as solid electrolytes in capacitors or batteries. All these issues will be addressed in the project as functions of the monomer structure and ionic liquid structure. Ionogels with optimized composition will be tested as solid electrolytes in electrochemical capacitors.

The proposed project was created in response to demand for immobilization of ionic liquids in solid matrices, while keeping their unique properties. The thiol-ene photopolymerization in ionic liquids gives the possibility to obtain in a fast and simple process **the new class of ionogel materials which can replace ionogels based on other matrices**. It is expected that the new ionogel products will be characterized by improved electrochemical properties required for materials used in conversion and energy storage systems. From the economic point of view, the proposed method of ionogel production is energy-efficient (photochemical initiation ensures short reaction time and ambient reaction temperature) and cost-effective (nitrogen blanketing is not necessary due to insensitivity of thiol-ene reaction to oxygen), which gives the project the pro-ecological aspect (in terms of production technology). The research proposed in the project is innovative and will significantly improve the current knowledge both in the field of ionogels as well as in the field of thiol-ene chemistry.