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The project is an example of the basic research, contributing to the innovative formation of membrane materials. The proposed materials will contain special type of ionic liquids, leading to the stable and durable structure.
Membrane is a barrier that separate two phases. Thanks to its composition and morphology, the selective transport of chosen mixture components can occur. First membranes have been created by Nature at the time of the appearance of life on Earth. However, the man began to explore and produce membranes for their own needs from the middle of the eighteenth century only, when the phenomenon of osmosis was discovered. The desire to produce new membrane materials and modification of existing ones is a source of inspiration for many researchers. The membrane materials are modified by using "ionic liquids" (Ils).

What is the ionic liquid?
Everybody knows, what is sodium chloride salt (or NaCl). To melt crystals of NaCl, a large amount of energy is needed (melting temperature of NaCl = 801^{o}C). This is associated with the crystalline structure of the salt - ions create a closely arranged network and the distances between ions are relatively small. Let's imagine what would happen in the presence of much, much bigger ions (cations and anions) in crystalline structure. In that latter case, the interactions between the ions will be much weaker. Subsequently, this will result in much less energy requirement for melting the salt. In some cases, the aforementioned salt exists in the liquid state at room temperature. This is the source of their name - "ionic liquids". Ionic liquids are exceptionally interesting and attracted the attention of many researchers. The design, formation and properties of ionic liquids are extensively studied. Examples of applications include: ILs as solvents, phase for the chromatographic columns, in the energy sector, environmental protection, and finally in the membrane separation processes. The membranes filled with ILs, possess one drawback - ionic liquids are progressively eluted from the membrane during application.

What we can do to keep the ILS in the membrane?
The obvious answer seems to be at the first glance surprising - the liquid should be permanently bound to the polymeric material forming membrane. This idea became a basis of the research hypothesis of the project - creation of a sustained polymer-ionic liquid system, stable in time. The authors of the project propose two pathways of research a) development of membranes containing polymerized ionic liquids (PILs) in the membrane structure (polymerized ionic liquid will create inter-polymer network, penetrating the membrane and forming polymer chains); b) utilization of the reactive ionic liquids (RILs), which form stable bonds with the functional groups of the polymer. Two types of polymer will be used for membranes creation: poly(vinyl alcohol) – PVA and cellulose acetate propionate (CAP).
Created at various experimental conditions polymeric materials containing ionic liquids (RILs and PILs) will be subsequently characterized in order to determine the most optimal material for membrane formation. The advanced statistical methods (so called chemometric methods) can help in choosing the most suitable membrane materials. Successively, the formed membranes will be extensively characterized by various analytical techniques, e.g. nuclear magnetic resonance, electron microscopy, infrared spectroscopy, and others. In a final step, the prepared membranes will be tested in chosen membrane separation processes (i.e. gas and vapor separation, separation of liquid mixtures, separation of metal ions) and as separators in fuel cells.

The final result of the project will be novel, efficient in separation processes and stable membrane materials. Implementation of this project will be carried out by an international French-Polish research team. Additional measurable effect of the project will be a "co-tutelle" (joint) PhD Thesis, prepared by one of the young member of the research team.