SYNTHESIS AND CHARACTERIZATION OF FUNCTIONAL PEEK FOR ION-EXCHANGE MEMBRANES

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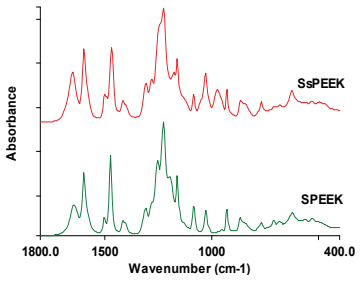
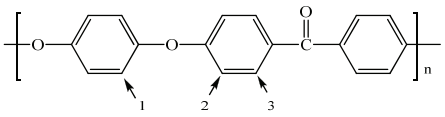
The ion-exchange membrane is rather advanced achievement of material science and it is widely used in various industrial fields: medicine, analytical chemistry, electro- and diffusion dialysis, sensors, both separator and solid polymer electrolyte in electrolysis, batteries, fuel cells, etc [1].The research on ion-exchange membranes has grown considerably in recent years with the growing interest in fuel cell technology for the automotive and portable applications [2]. The requirements for a good membrane are: high chemical stability, high proton conductivity, low fuel and oxygen permeabilities and preferentially low cost [3]

The sulfonated and sulfinated polyetheretherketone (SsPEEK) was prepared via a novel method. SsPEEK has two types of functional groups, the functional groups for ion-exchange and the functional groups for further strengthening of the ion-exchange membrane by cross-linking. The discussed membrane is low cost due to the use of non-expensive chemicals and simple production procedure.



Comparative spectra of SPEEK and SsPEEK



Structure of PEEK positions marked with arrows is possible sites of substitution.

***Structure of PEEK positions marked with arrows is possible sites of s*Sulfonation for PEEK can be performed in several ways with different sulfonating agents, such as concentrated sulfuric acid, sulfur trioxide, chlorosulfonic acid, a sulfur trioxide-triethyl phosphate complex, and trimethylsilylchlorosulfonated [1]. Sulfonation of PEEK in sulfuric acid is an electrophilic substitution reaction, in which the sulfonic groups are introduced into the hydroquinone segment of the polymer activated for electrophilic substitution by the ether linkage chain [2-5].**

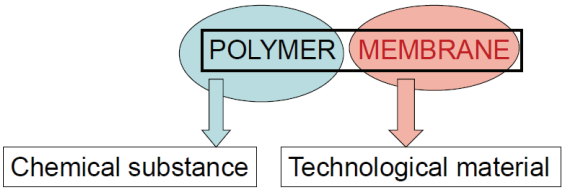
Chlorosulfonic acid is strong acid which is widely used as a powerful sulfonating agent [6]:

$Ar\text{-}H + ClSO_3H \rightarrow Ar\text{-}SO_3H + HCl$

An equimolar amount of chloroslfuric acid or an excess of the chlorosulfonic acid also can be used for chlorosulfonation of aromatic compounds:

$Ar\text{-}H + 2ClSO_3H \rightarrow Ar\text{-}SO_2Cl + HCl + H_2SO_4$

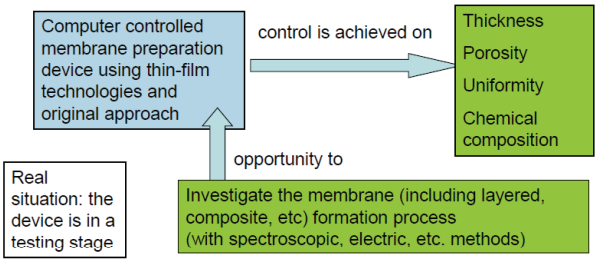
Complexity of research approach



Typically, polymer membranes in research laboratories are prepared using methods for chemical substance preparation and studied using methods suitable for both characterizing substances and technological materials. However, the substance characterization is extrapolated and used as a material characterization.

How to solve the problem?

High control of membrane formation process allows to form multilayer membranes and nanocomposites. The project is to design the laboratory equipment to prepare sample membranes with technological quality and to study the preparation process *in situ*.



References:
1. Sata, T., *Ion Exchange Membranes: Preparation, Characterization, Modification and Application*. 2004: Royal Society of Chemistry.
2. Vielstich, W., A. Lamm, and H.A. Gasteiger, *Handbook of Fuel Cells*. 2003, New York: John Wiley & Sons.
3. Nunes, S., I. Wiley, and I. Sons, *Membrane Technology*. 2001: Wiley-VCH.