Hybrid membranes containing star-like macromolecules with ionic liquids for effective liquid separation

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Lactic acid has wide application in food, cosmetic and chemical manufacture as a solvent due to its versatility, non-toxicity and biodegradability. The primary costs in its production are the complex purification processes. Separating lactic acid from water is possible using advanced membrane technology. Among the processes of membrane separation, pervaporation is an efficient way of separating liquid mixtures, especially in the case of close-boiling and azeotropic ones since it allows to reduce the need for energy and additional components.

Polymer membranes are increasingly used in the field of membrane separation methods due to their high stability and low cost. Considering the advantages of polymer membranes, a modification of polymer matrix with various fillers may be an interesting solution for the development of membranes with improved operational and transport properties.

In the last decade, ionic liquid (IL) membranes have gained significant attention because of their advanced properties and significant influence on permeate flux and selectivity.

However, during the pervaporation performance, the loss of ILs out of the polymer matrix may occur. Consequently, there is a need to improve a method of more stable IL immobilization.

This study focuses on preparation of high selective hybrid membranes using star-like macromolecule (SLM) containing fullerene C_{60} with added IL. Glassy poly(2,6-dimethyl-1,4-phenylene oxide) (PPO) was selected as the polymer matrix due to its low cost, high mechanical strength and well-known good pervaporation performance. SLM consist of a small core C_{60} and 6 arms of nonpolar polystyrene (PS) and 6 polar copolymers of poly(2-vinylpyridine-block-poly-tret-butylmetacrylate) (P2VP-PTBMA). The ionic liquid 1-butyl-3-methylimidazolium bis(trifluoromethylsulfonyl)imide was used as a filler.

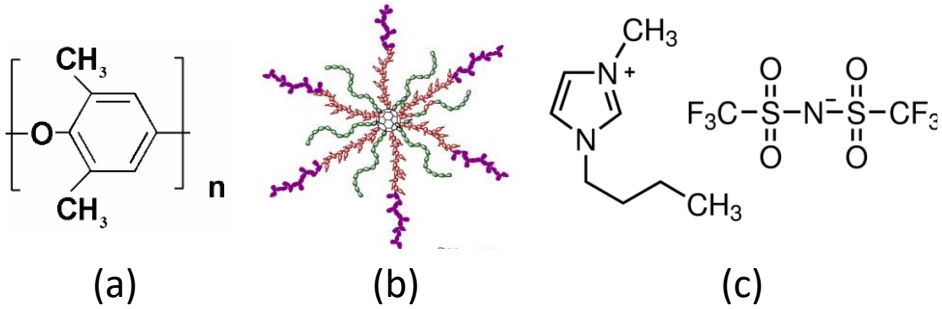

Figure 1. Scheme of PPO (a), star-like macromolecule (b), and ionic liquid (c)

The main aim was to study the influence of SLM + IL addition on the physicochemical, and separation properties of the PPO based membranes. The effect of fillers on film structure was studied using X-ray analysis and SEM. Furthermore, thermal and other physicochemical properties were investigated via TGA, DSC, determination of contact angles. The transport separation properties of membranes were investigated in the pervaporation process of water – lactic acid mixture.

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