Novel CO2-Selective Blend Membranes Based on Polyvinylalcohol (PVA) and 1-Ethyl-3-Methylimidazolium Dicyanamide ([emim][dca]) Ionic Liquid for Effective CO2/H2 Separation.

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The tremendous potential of the membrane separation processes (MSP) has been recognized during past decades. Compared to the traditional separation processes such as cryogenic distillation, scrubbing or pressure swing adsorption, MSP represent modern, clean separation technique with low energy demands. Thus, MSP contribute positively to a perquisite development of alternative, renewable or low environmental impact energy sources. Despite the fossil fuels are still expected to be the predominant resource of energy in the near term of next 20 years, it is of great importance to develop more efficient ways for sustainable development in future. In this context, hydrogen has been extensively accepted as a clean and efficient energy carrier and storage medium to alleviate the mounting global energy and environmental crisis. In past decade, the room temperature ionic liquids (RTIL) were recognized as attractive materials for specific applications due to their suitable properties (tailorable structure variations, good thermal stability, extremely low volatility, ability to dissolve a large range of compounds). Namely their extremely high physical and chemical CO_2 affinity (solubility) allows targeted gas separation applications.

The ionic liquid based membranes usually consist of a porous membrane as a support, saturated with the room temperature ionic liquid (RTIL). The ionic liquid is typically trapped inside the pores by capillary forces and/or it is polymerized there. Alternatively, a high RTIL content leads to the creation of a polymer gel, in which the RTIL is entrapped in the tight spaces between individual polymer chains or clusters thereof or by a covalent bond. In our previous work we found that these membranes were shown to have a very interesting selectivity for CO_2/H_2.

The supported room temperature ionic liquid membranes are prepared from newly synthesized highly CO_2 sorbing imidazolium-based ionic liquids with the oxygen containing alkyl chain and anions differing in basicity with the suitable polymer based support.

This study confirms the positive effect of ionic liquid content in neat polymer on mix gas (CO_2/H_2) separation. The sorption of CO_2 increases with increasing content of [emim][dca] in PVA polymer membranes. The sorption of H_2 was negligible in all measured membranes even with highest content of [emim][dca] in PVA. All single gas permeation experiments clearly show increasing permeability of CO_2 and H_2 with increasing content of ionic liquid in studied polymer. During separation of both gasses, the solution diffusion mechanism is applied. Based on these results we can state that with higher content of [emim][dca] in PVA permeability of both gasses and also ideal selectivity increases. This observation shows a potential of IL where is higher sorption of CO2 than in polymer as good separation medium for CO_2/H_2 separation.

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