Gas Separation by Supported Ionic Liquid Membranes

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The use of ionic liquids (ILs) for gas separation processes recently has attracted much attention due to high solubilities of different gaseous species in ionic liquids [1]. The preparation of supported ionic liquid membranes (SILMs) is also reported for selective separation of different organic or gaseous compounds. Research activities have amongst others focused on CO_2 separation from gas streams, representing a topic of world wide interest, the decrease of global warming causing gas emissions and, increasingly, the refinement of biogas for the feed-in of biologically produced methane into conventional natural gas distribution networks.

Other interesting contaminants in many industrial gas streams are sulphur compounds. H_2S as a toxic and corrosive substance is found nearly in all natural gas sources, synthesis gas and biogas streams. SO_2 emissions are generated wherever fossil fuels are combusted. Other sulphur compounds, like tetra-hydrothiophene (THT), are added to natural gas as odorants, making it impossible to be directly used in peripheral catalytic processes like home-based fuel cells for heat and electricity generation due to catalyst poisoning.

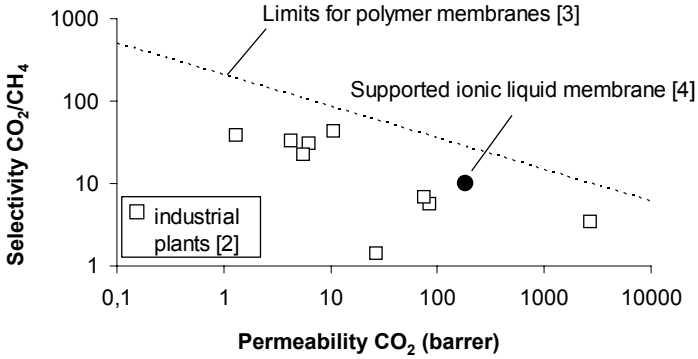

Fig. 1: CO_2 permeability and selectivity of industrial relevant membrane processes and supported ionic liquid membrane process for CO_2/CH_4 separation
(1 barrer = $75 \cdot 10^{-10}$ cm^3 (STP) cm cm^{-2} s^{-1} bar^{-1})

The present investigation shows the possibility to separate continuously gas compounds like CO_2, H_2S, THT and SO_2 from N_2 or CH_4 with supported ionic liquid membranes [5]. Therefore an adequate porous support material, e.g. a polymer film, was coated by ionic liquids and was successfully tested for continuous separation of CO_2 and sulphur compounds from different gas mixtures. The influence of support properties, ionic liquid and gas flow on the achievable degree of separation, i.e. permeability and selectivity was studied. The results indicate that competitive selectivities and permeabilities compared to industrial relevant processes based on polymer membranes can be achieved (Fig. 1). Based on solubility and diffusivity properties of the ionic liquids the task specific synthesis of ILs gets a new challenge to exceed the conventional polymer membranes efficiencies.

References

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