ULTRA-THIN HYDROPHOBIC MFI MEMBRANES

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Hydrophobic MFI membranes with a film thickness of as low as about 600 nm and with a very low amount of defects were grown on graded alumina supports at near neutral pH using fluoride as mineralizing agent (TPAF-MFI membranes). These membranes are more than 10 times thinner than previous membranes prepared using fluoride for which separation performance has been reported. For comparison, MFI membranes with a film thickness of about 500 nm were grown at high pH using hydroxide as mineralizing agent (TPAOH-MFI membranes). The membranes were calcined and the amount of defects was determined using permoporometry. The TPAF-MFI membranes had about half the amount of defects as compared to the TPAOH-MFI membranes and most of the defects in both membranes were smaller than 1 nm. The membranes were evaluated for separation of a feed of 5 kPa *n*-butanol, 5 kPa water and 91 kPa helium using 101 kPa helium sweep. Both membranes displayed high permeance and the TPAF-MFI membrane was more selective to *n*-butanol than the TPAOH-MFI membrane in the whole investigated temperature range, see Figure 1. The higher selectivity for the former membrane should be a result of lower amount of defects and silanol groups and higher hydrophobicity. Interestingly, the total permeance and *n*-butanol/water separation factor increased to $11 \times 10^{-7} \text{ mol s}^{-1} \text{ m}^{-2} \text{ Pa}^{-1}$ and 19, respectively, after activation of the TPAF-MFI membrane at 300 °C in a helium flow saturated with *n*-butanol at 25 °C. The butanol activated TPAF-MFI membrane displayed a CO_2/H_2 separation factor of 6 at 25 °C and a CO_2 permeance of $26 \times 10^{-7} \text{ mol s}^{-1} \text{ m}^{-2} \text{ Pa}^{-1}$ for a feed of 450 kPa CO_2 and 450 kPa H_2 and 101 kPa helium sweep gas. Further evaluation of the separation performance of the TPAF-MFI membranes is ongoing.

Figure 1 Separation performance of the MFI membranes for a feed of *n*-butanol/water/helium.