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Generation of PEEK-WC membranes by supercritical fluids

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1. Introduction

Today the majority of membranes used in microfiltration, ultrafiltration, dialysis and controlled release are prepared from a homogenous polymer solution by the dry/wet phase inversion method [1,2]. The intrinsic physicochemical properties of PEEK-WC, a modified poly(ether ether ketone), make this polymer an interesting precursor of membranes to be used in different separation processes. In this work we present a new method to prepare PEEK-WC membranes using supercritical fluids based phase inversion process, in which the supercritical fluid acts as non-solvent [3]. Compared to the traditional dry/wet phase inversion method, the supercritical fluids allow advantageously to modulate the cell size and the membrane morphology by changing the operative conditions; moreover, a dry membrane can be obtained rapidly and without additional post-treatments.

2. Theory and experimental

We studied a semi-batch process: the polymer solution is placed inside a vessel that is

then heated and filled with the supercritical fluid. The supercritical fluid fluxes through the vessel causing the phase separation and drying the phase-separated membrane. A flat membrane is generated. Series of experiments were performed at different polymer concentrations, temperatures, pressures and with different solvents and supercritical fluids, in order to analyze the effect of these process parameters on membranes morphology and cell size. Structures and properties transport were compared with those of PEEK-WC membranes prepared by using traditional dry/wet phase inversion.

3. Results and discussion

Depending on the process conditions, we obtained membranes with different morphologies comparable to those of traditional PEEK-WC, characterized by finger-like or sponge-like structures, and with dense or porous skin, as SEM images evidenced (Fig. 1).

The traditional membranes exhibited skin layers dense or with pores of 50 nm, when pore formers were used (Fig. 2). Differently, surfaces with larger pore size were produced by

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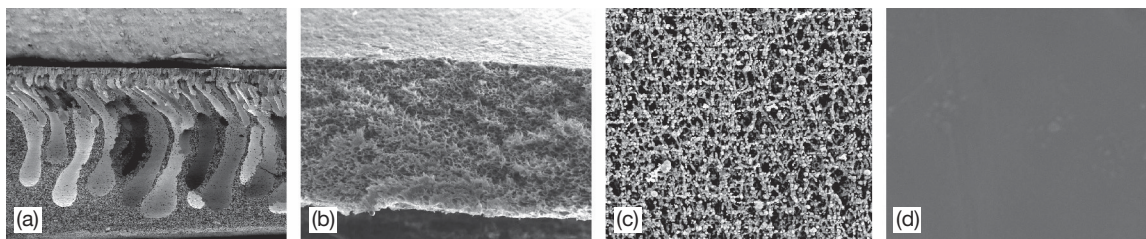


Fig. 1. SEM images of PEEK-WC membranes prepared by supercritical fluid techniques: (a) finger-like section, (b) sponge-like section, (c) porous skin (d) dense skin.

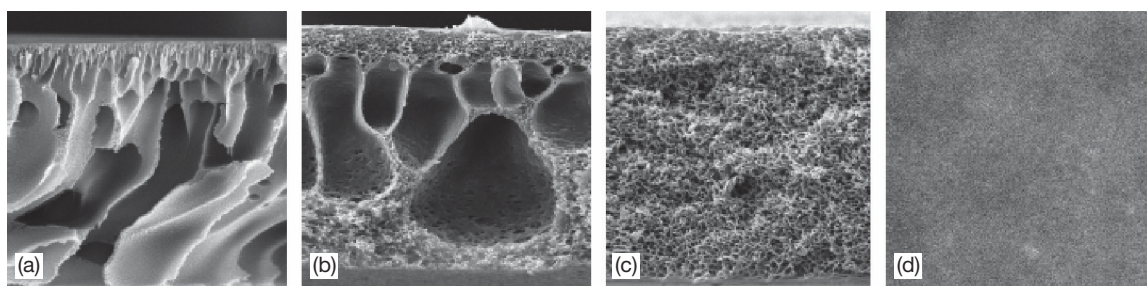


Fig. 2. SEM images at different enlargement of PEEK-WC membranes prepared by dry/wet phase inversion techniques: (a,b) finger-like sections, (c) sponge-like section, (d) skin.

varying the conditions of the supercritical fluid treatment and preventing, therefore, the chemistry of PEEK-WC membranes to be modified. As a result, the transport through porous matrixes

was increased, due to the reduced mass transfer resistance. A comparison of N_2 fluxes through porous membranes prepared according to different methods is reported in Fig. 3a,b.

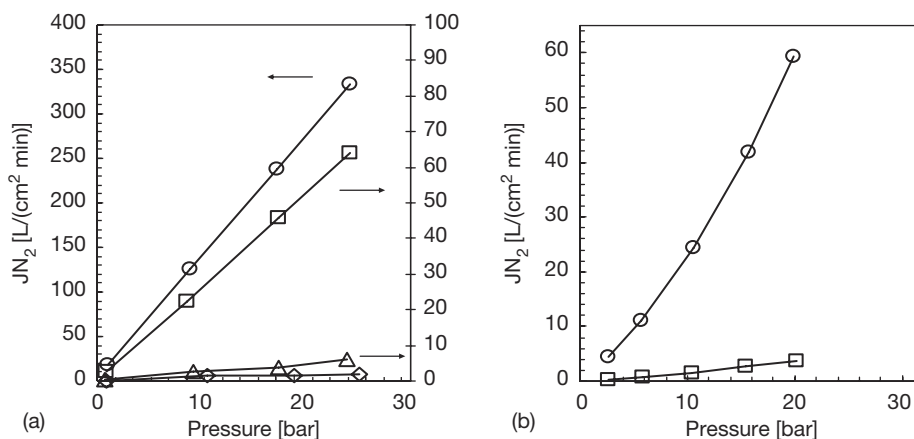


Fig. 3. Flux of N_2 estimated at different pressure and 20°C: (a) membranes prepared by supercritical fluid; (b) membranes prepared by dry/wet phase inversion.

4. Conclusions

PEEK-WC membranes were produced using the supercritical fluids assisted phase inversion method. By changing the process parameters it is possible to modify the velocity of the demixing process, modulating continuously the cell size and the final membrane morphology. The versatility of the process and the clean technology make this approach interesting in the preparation of PEEK-WC membranes, which could find application in different membrane processes.

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