NEW POLYMERS AS ADDITIVES IN DIALYSIS TREATMENT BLENDED MEMBRANES FOR LONG TERM FILTRATION

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Introduction

Dialysis is the one of the commonly used therapies for patients with End Stage Kidney Disease. There, a hollow fiber (HF) membrane-based dialyzer is applied for filtering the uremic toxins from patients' blood [1]. These membranes are most based on hydrophobic polymer, such as polysulfone (PES), and hydrophilic polymer additives such as polyvinylpyrrolidone (PVP) [2]. However, during therapy, PVP can be eluted, from the HF resulting in decreased hemocompatibility [3,4] For achieving prolonged dialysis leading to improved toxin removal [5], one needs to fabricate fibers that do not elute hydrophilic additive over the course of the dialysis treatment. Based on earlier studies done by other researchers [6,7] as well as one done in our group [8], here, we investigate the application of sulfonated polymers and copolymers as hydrophilic additive for HF dialysis membranes. We hypothesize that these additives will provide membranes with high flux combined to low additive leakage during long term therapy.

Methods

The polymer dopes consisted of PES (as membrane forming polymer) and PVP, sulfonated polyphenylsulfone (sPPSU) or copolymers (as additives) are dissolved in N-Methyl-2-pyrrolidone (NMP). Various compositions were investigated. HF membranes were prepared by wet spinning using liquid induced phase separation. Various spinning conditions (polymer speed, bore speed, bore composition, pull wheel speed) were investigated. The HF were washed and air dried at room temperature and their morphology was characterized via scanning electron microscopy (SEM). For all membranes we performed clean water flux measurements and for selected membranes we investigated albumin rejection, PVP elution and transport studies with human plasma.

Results

Figure 1 presents typical SEM image of hollow fiber obtained from blend consisting of PES, sPPSU and PVP (PES/sPPSU/PVP). The fibers have spongy structure and selective layer located on the inside of the fiber. The membrane ultrafiltration coefficient (K_{UF}) puts the fibers in low flux range and is comparable to F8HPS (Fresenius) dialyzers. (Table 1). The fibers are mechanically stable and can be used with trans membrane pressure (TMP) up to 2 bars.

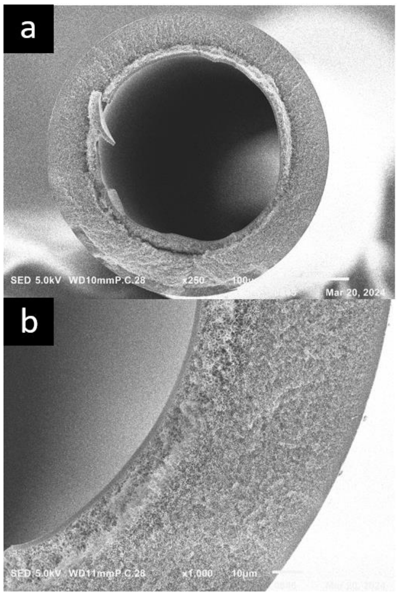

Figure 1: Cross-section of PES/sPPSU/PVP fiber: a) whole fiber cross-section magnification of x250, b) fiber wall, magnification x1000.

Fibers	Inner dimeter µm	K_{UF} [mL/(m^2*h*mmHg)]
PES/sPPSU/ PVP	262 ± 21	11 ± 3
F8HPS[8]	191 ± 9	10 ± 4

Table 1: Inner diameter and ultrafiltration coefficient of PES/sPPSU/PVP and F8HPS.

Discussion

By adjusting polymer dope and bore composition we can increase further the membranes' K_{UF} and proceed to detailed transport studies. Our first studies indicate that the blend composition and bore liquid can have a significant effect to the membrane morphology, mechanical properties, and overall performance.

References

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