Supplementary Information:

UV-crosslinked chitosan/polyvinylpyrrolidone blending membranes for pervaporation

Qiu Gen Zhang, Wen Wei Hu, Ai Mei Zhu and Qing Lin Liu**

Department of Chemical & Biochemical Engineering, College of Chemistry & Chemical Engineering, Xiamen University, Xiamen 361005, China

E-mail: qgzhang@xmu.edu.cn (Q.G. Zhang), qlliu@xmu.edu.cn (Q.L. Liu)

Caption of tables and figures

Table S-1 Composition of the UV-crosslinked chitosan/PVP blending membranes and irradiation time.

Fig.S-1 Weight of the blending membrane containing 9.09 wt% PVP and its UV-crosslinked counterpart in 85 wt% ethanol aqueous solution *vs.* extraction time.

Fig.S-2 Effect of irradiation time on color of the UV-crosslinked chitosan/PVP blending membranes containing 9.09 wt% PVP.

Fig.S-3 Top-view SEM images of the blending membrane containing 9.09 wt% PVP and its UV-crosslinked counterpart (irradiation for 4 min).

Fig.S-4 Density of the UV-crosslinked chitosan/PVP blending membranes at 25 °C.

Fig.S-5 Individual flux of methanol and EG through the UV-crosslinked chitosan/PVP blending membranes in pervaporation at 60 °C.

Fig.S-6 Swelling properties of the UV-crosslinked chitosan/PVP blending membranes in the 85 wt% ethanol aqueous solution at 25 °C: effect of (a) PVP content and (b) irradiation time.

Part. A Composition and irradiation time of the membranes

As shown in Table S-1, the effects of PVP content and irradiation time on structure and properties of the UV-crosslinked chitosan/PVP membranes were investigated. To study the effect of PVP content, membranes Nos. 1 to 5 containing various PVP contents from 0 to 16.7 wt% are crosslinked *via* irradiation for 4 min. On the other hand, membranes No. 4 and Nos.6 to 9 with 9.09 wt% PVP are crosslinked *via* irradiation for various times from 0 to 8 min at the interval of 2 min.

Table S-1 Composition of the UV-crosslinked chitosan /PVP blending membranes and irradiation time.

No.	Chitosan (wt%)	PVP (wt%)	Irradiation time (min)
1	100	0	4
2	95.24	4.76	4
3	93.75	6.25	4
4	90.91	9.09	4
5	83.30	16.70	4
6	90.91	9.09	0
7	90.91	9.09	2
8	90.91	9.09	6
9	90.91	9.09	8

Part. B Exaction of the membranes in ethanol aqueous solution

To investigate the extraction of the UV-crosslinked membranes in the feed, the blending membrane containing 9.09 wt% PVP and its UV irradiated counterpart were dried in a vacuum oven at 100 $^{\circ}$C, weighted and then immersed in 85 wt% ethanol aqueous solution. After tens of hours, they were dried again in the vacuum oven at 100 $^{\circ}$C and weighted to get the dried weight, as shown in Fig.S-1.

PVP fraction suffered extraction in the aqueous solution. However, the weight decline of the membrane began to level off after 24 h as shown in Fig.S-1. This suggests that the membrane is stable and the PVP does not extract after being immersed into the feed for 24 h. The blending membrane and its UV irradiated counterpart had 3.90 and 3.73 wt% weight loss respectively. In this work, the membrane samples were immersed in the liquid mixture for 48 h. After that, they were assembled to perform pervaporation. Therefore, pervaporation performance of the as-prepared membranes is stable and reliable.

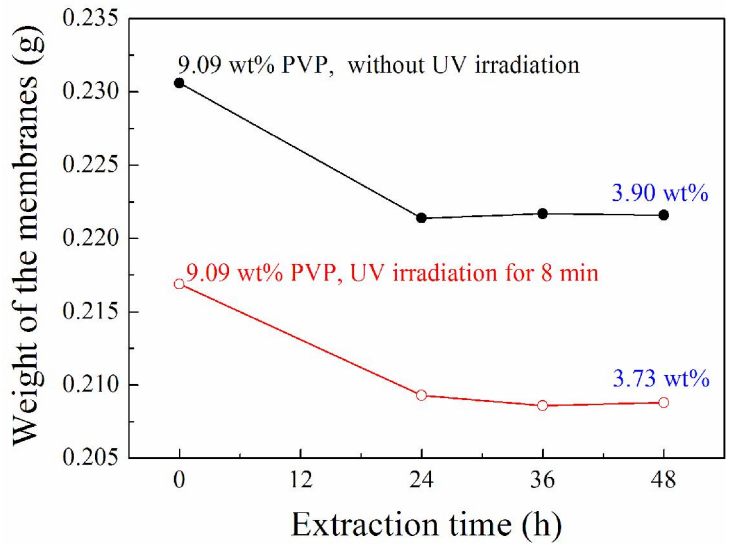

Fig.S-1 Weight of the blending membrane containing 9.09 wt% PVP and its UV-crosslinked counterpart in 85 wt% ethanol aqueous solution *vs.* extraction time

Part. C Characterization of the membranes

Fig.S-2 shows photos of the UV-crosslinked chitosan/PVP blending membranes irradiated for different times. All of the as-prepared membranes are transparent. However, their color deepened with increasing irradiation time. The membrane irradiated for 8 min is in deep yellow. This is because the reaction degree of the membranes increased with extending irradiation time.

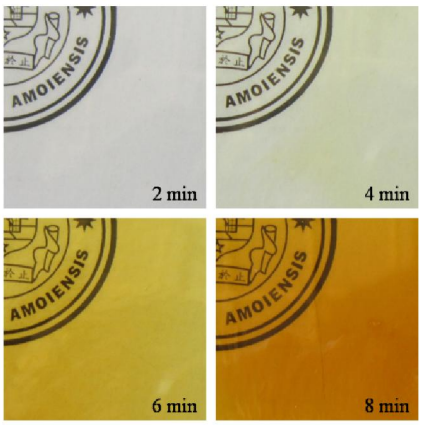

Fig.S-2 Effect of irradiation time on color of the UV-crosslinked chitosan/PVP blending membranes containing 9.09 wt% PVP.

Fig.S-3 shows top-view SEM images of the blending membrane containing 9.09 wt% PVP and its UV-crosslinked counterpart (irradiation for 4 min). The blending membrane has a smooth surface at the microscale, and the irradiated counterpart has also a smooth surface.

Fig.S-4 shows the density of the UV-crosslinked chitosan/PVP blending membranes measured by a digital microbalance (AB204-S, *Mettler Toledo*, USA) with density kit at 25 °C.

The membrane density almost linearly decreased with increasing PVP content, whereas first increased rapidly and then slightly with extending irradiation time. UV irradiation made the blending membranes more compact.

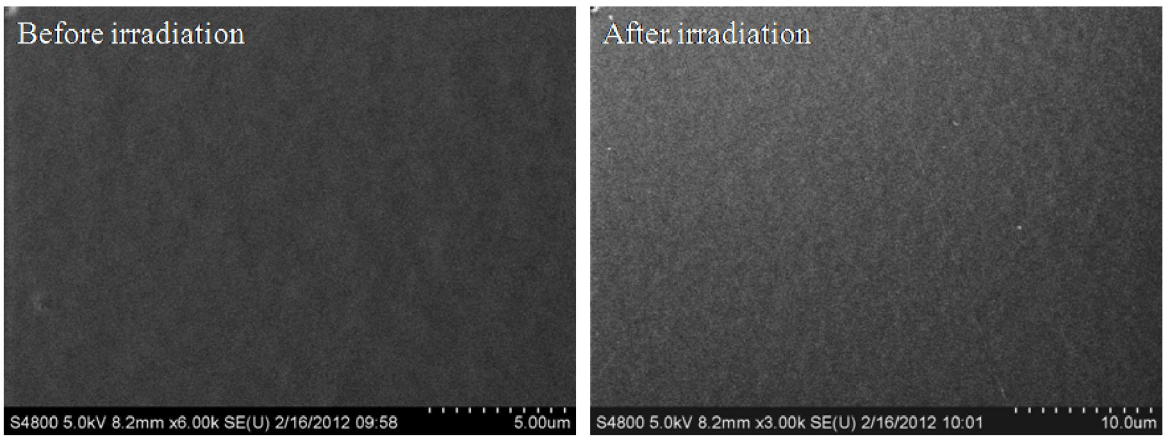

Fig.S-3 Top-view SEM images of the blending membrane containing 9.09 wt% PVP and its UV-crosslinked counterpart (irradiation for 4 min).

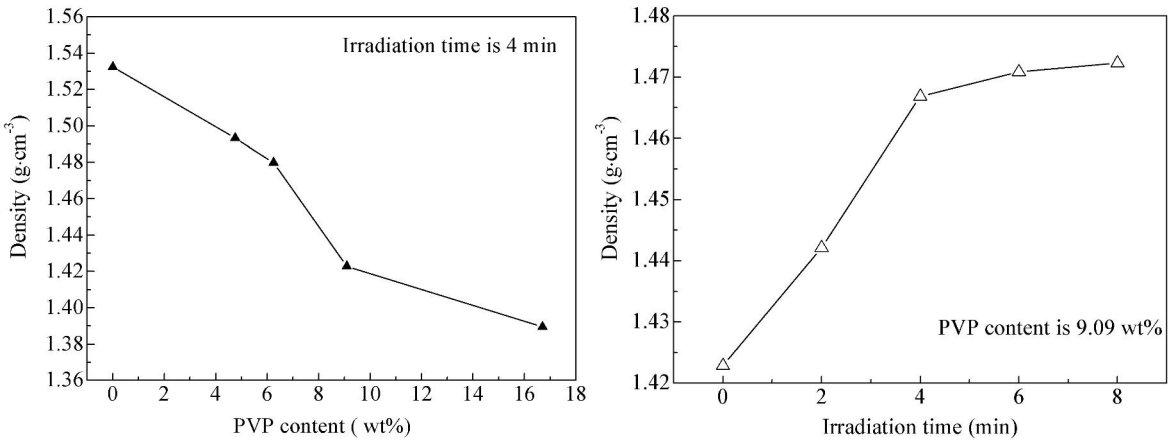

Fig.S-4 Density of the UV-crosslinked chitosan/PVP blending membranes at 25 °C.

Part. D Pervaporation performance of the membranes

Fig.S-5 shows individual flux of methanol and EG through the UV-crosslinked chitosan/PVP blending membranes in pervaporation at 60 °C. The individual flux of methanol through the membranes increased with increasing PVP content, whereas that of EG first decreased and then increased (Fig.S-5a). Besides, individual flux of both methanol and EG decreased with extending irradiation time (Fig.S-5b). However, the latter has a greater decrease than the former since EG molecule is bigger than methanol.

Fig.S-6 shows swelling properties of the as-prepared membranes in 85 wt% ethanol

aqueous solution. The degree of swelling enlarged with increasing PVP content and decreased with extending irradiation time. Instead, water sorption selectivity reduced with increasing PVP content and increased with extending irradiation time. Solubility of the chitosan membrane in ethanol aqueous solution was enhanced by PVP blending and UV-crosslinking. Compared to the pristine chitosan membrane, the membrane containing 9.09 wt% PVP with 8 min UV irradiation has a similar degree of swelling and higher water sorption selectivity.

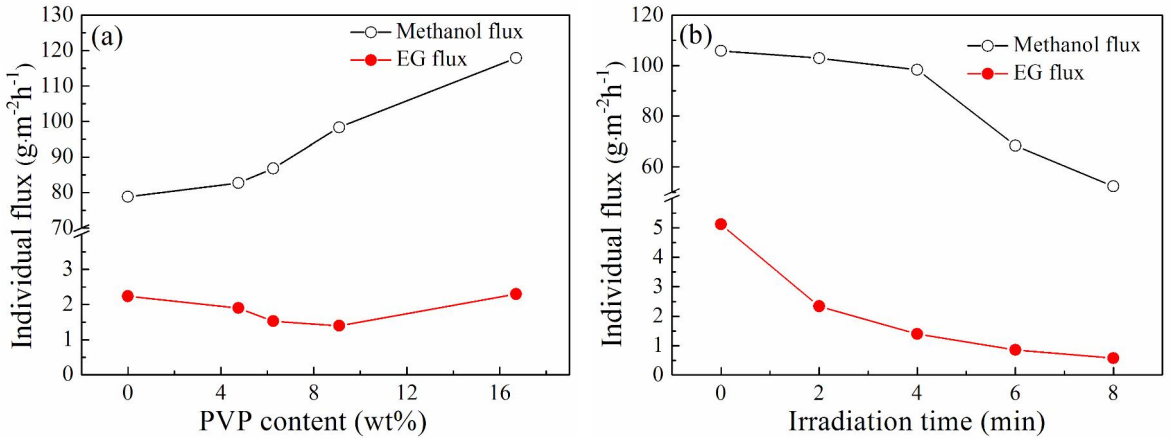

Fig.S-5 Individual flux of methanol and EG through the UV-crosslinked chitosan/PVP blending membranes in pervaporation at 60 °C.

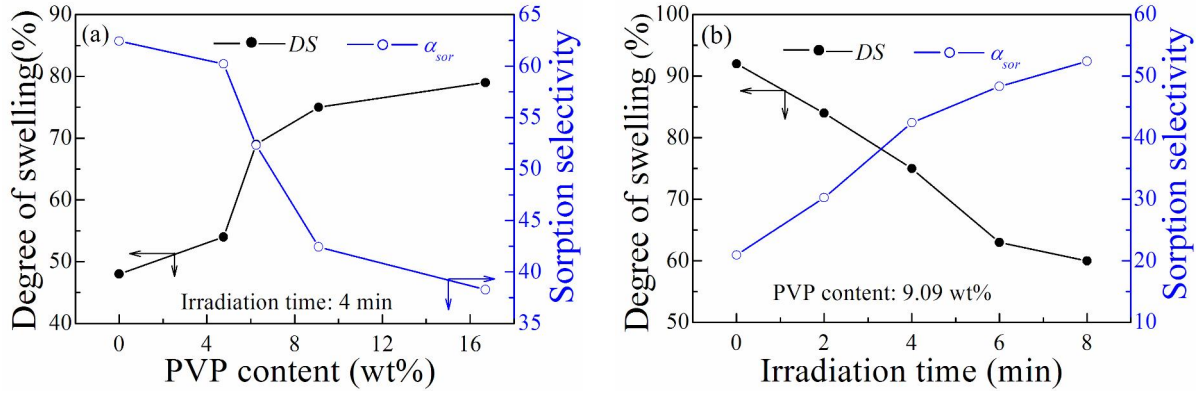

Fig.S-6 Swelling properties of the UV-crosslinked chitosan/PVP blending membranes in 85 wt% ethanol aqueous solution at 25 °C: effect of (a) PVP content and (b) irradiation time.