Fabrication of novel polyelectrolyte complex membranes containing strong-acid groups for pervaporation dehydration

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Introduction

Polyelectrolyte complexes (PECs) are blended at the molecular level and classified as a type of multi-component polymeric materials. PECs have been performed as a promising candidate for membrane (PECM) application ranging from pervaporation (PV), nanofiltration to the proton exchange membrane as well as gas separation. These homogenous PECMs made from soluble PECs exhibited very high PV performance in organics dehydration. Owing to the high hydrophilicity and strong interaction formed by sulfate (SO_3) groups [1], the SO_3 groups could enhance the water channels embedded in PECMs hydrophilicity and mechanical properties [2].

In this work, the PECMs containing different states of SO_3 groups were fabricated. It was found that the free SO_3 groups was capable of effectively improving the PV performance while the complexed ones enhancing the mechanical properties of PECMs.

Experimental

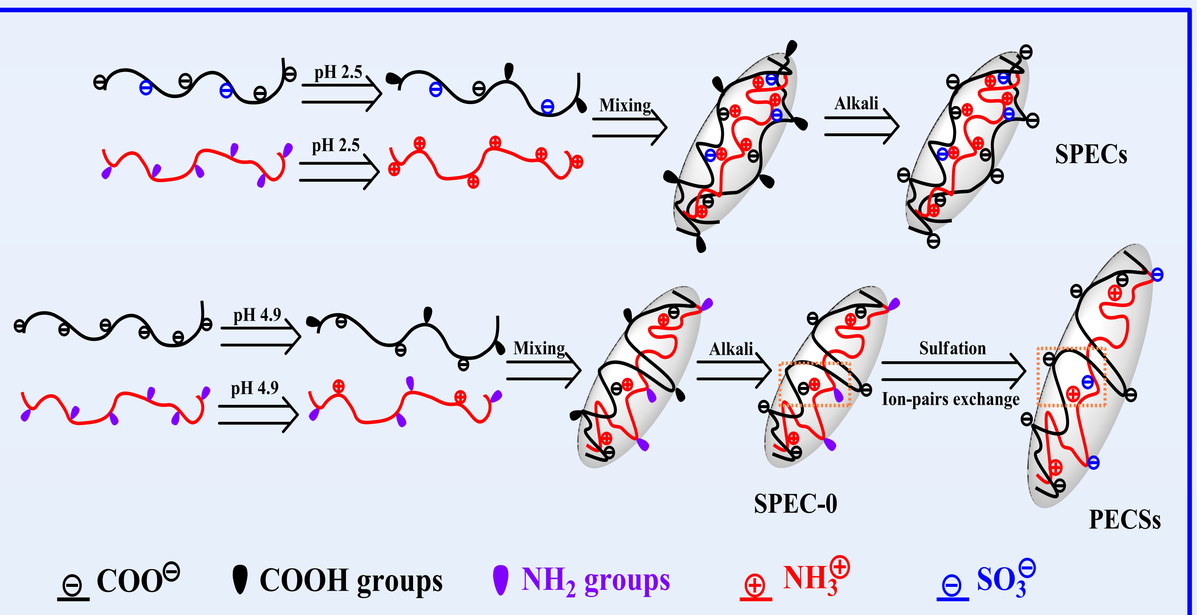

Fig. 1 Schematic diagram of PECs containing strong acid groups .

Results and discussion

I. Characterization of PECs

Table 1 Composition of PECs determined by XPS

Sample	S (At. %)	N (At. %)	S:N	X	Corresponding PECM
SPEC-0	----	1.57	0	0	SPECM-0
SPEC-10	0.74	1.72	0.43	10	SPECM-10
SPEC-25	1.51	1.95	0.77	25	SPECM-25
SPEC-35	2.39	2.74	0.87	35	SPECM-35
PECS-0	----	3.69	0	0	PECSM-0
SPEC-7	0.46	3.53	0.13	7	PECSM-7
SPEC-13	0.79	2.57	0.30	13	PECSM-13
SPEC-20	0.97	1.98	0.49	20	PECSM-20

PECMs with different compositions

II. Characterization of PEC and their membranes

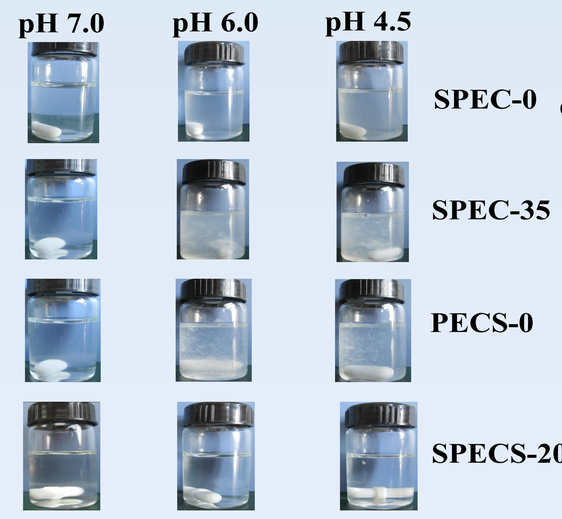

Fig. 2 Optical micrographs of PECs versus pH.

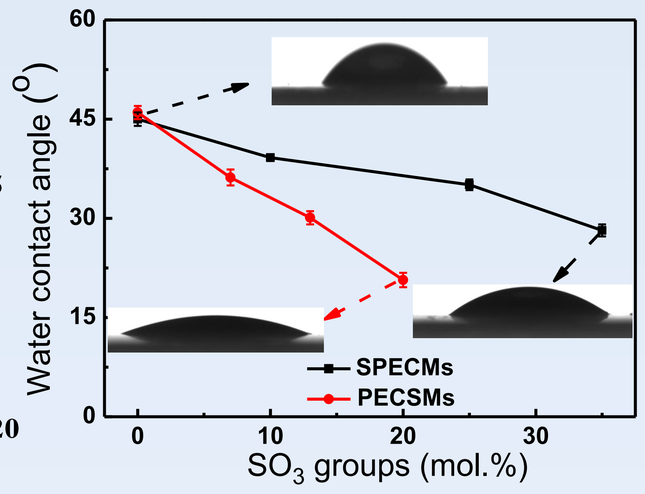

Fig. 3 Effect of SO_3 on PECMs hydrophilicity

Synthesis of PECs with different states of SO_3 groups

III. PV dehydration of PECMs

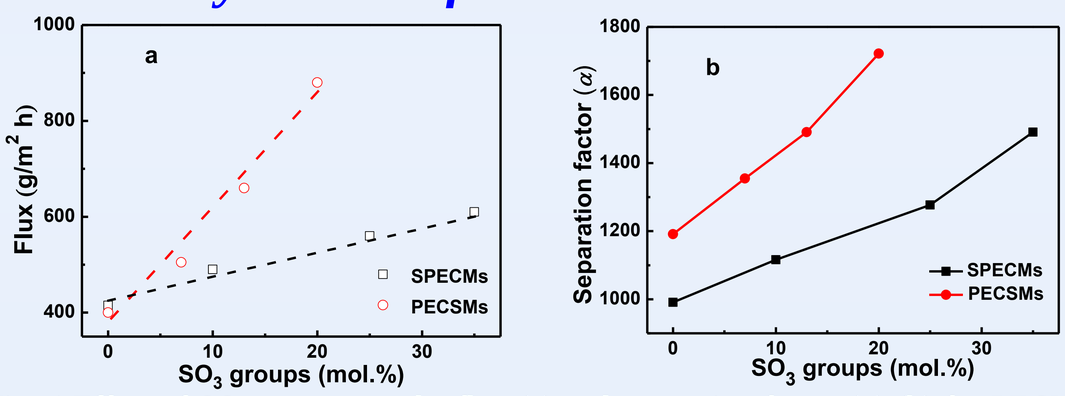

Fig. 4 Effect of SO_3 content on the flux (a) and separation factor (α) (b) for PECMs in the dehydration of 10 wt. % water-ethanol mixtures at 50 °C.

IV. Mechanical properties of PECMs

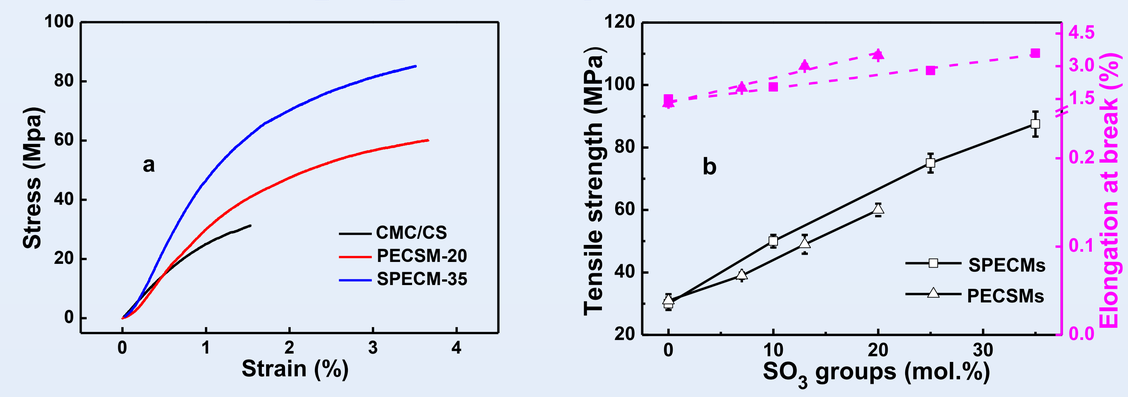

Fig. 5 Typical stress-strain curves of PECMs based on different states of SO_3 groups (a) and effect of SO_3 content on of the mechanical properties of PECMs (b).

Conclusions

- **Synthesis of novel PECMs containing SO_3 groups.**
- **Free SO_3 effectively improved PECMs PV dehydration.**
- **Complexed SO_3 availably enhanced PECMs mechanical properties.**

References

[1] D.V. Pergushov, A.H.E. Müller, F.H. Schacher, *Chem. Soc. Rev.* 2012, *41*, 6888.
[2] X.S. Wang, Q.F. An, T. Liu, etc., *J. Membr. Sci.* 2014, *452*, 73.

Acknowledgements

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