Novel Polyelectrolyte Complex Membranes Containing Dual Anionic Groups for Pervaporation Dehydration

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Background

Polyelectrolyte complexes (PECs), being a type of multi-component polymeric material formed by ionic complexation between oppositely charged polyelectrolytes, have been proved as a promising candidate for versatile membrane application ranging from pervaporation (PV) and nanofiltration to the proton exchange membrane for fuel cells. The homogenous PEC membranes (PECMs) made from soluble PECs, which were prepared with weak poly-acid and strong cationic polyelectrolyte in acidic conditions and they exhibit very high PV performance in organics dehydration. However, the high performance of these PEC membranes might be reduced somehow under harsh operation conditions such as acidic aqueous feed due to the disruption of pure weak ion-pairs. To address this problem, our current research focus was moved to introduce strong acid groups such as sulfonate acid groups into these PECMs. It is expected that strong acid groups can entitle PECMs with high PV and mechanical performance as well as the ability to resist acids in dehydrating acidic organic as result of their higher hydrophilic property and stronger ionic interaction with cationic polyelectrolyte.

Experimental

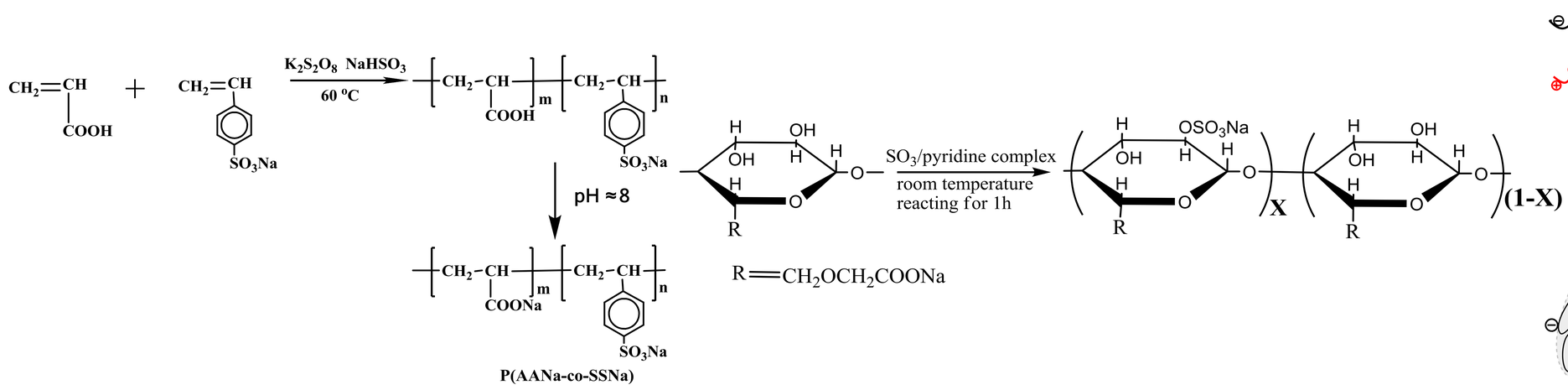

Fig. 1 Schematic of synthesis of P (AANa-co-SSNa), SCMC and their PECs (SPECs).

Results and discussion

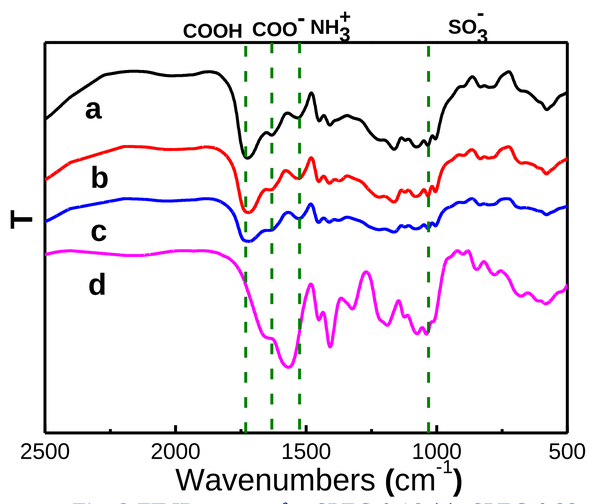

Fig. 2 FT-IR spectra for SPEC-0.16 (a), SPEC-0.23 (b), SPEC-0.30 (c) and SPECM-0.30 (d)

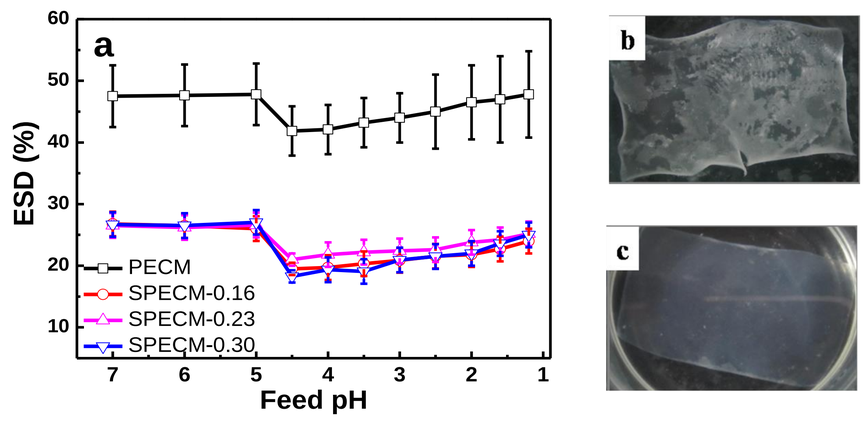

Fig. 3 (a) Effect of feed pH on equilibrium swelling degree (ESD), (b, c) Photographs of PECM and SPECM-0.30 after immersion in pH3 feed.

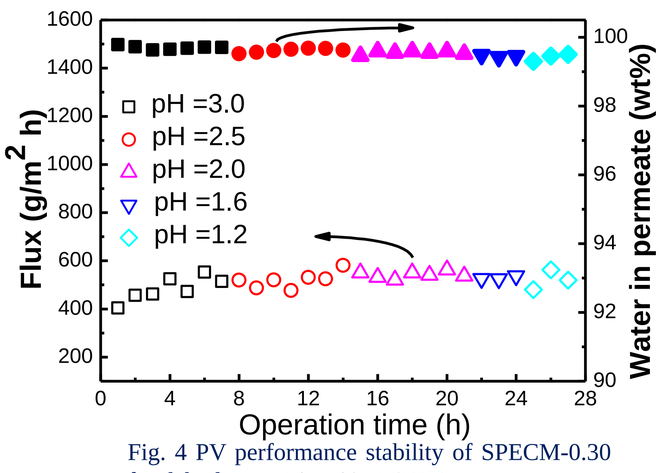

Fig. 4 PV performance stability of SPECM-0.30 for dehydrating 10 wt% H_2O/IPA.

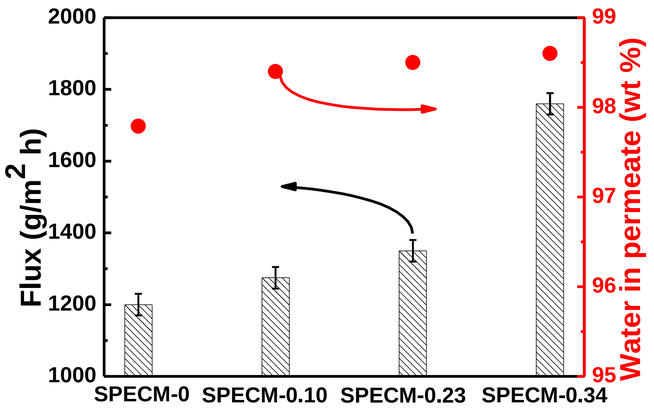

Fig. 5 Effect of chemical composition of SPECMs on PV performance in dehydrating 10 wt% H_2O/EtOH at 50 °C

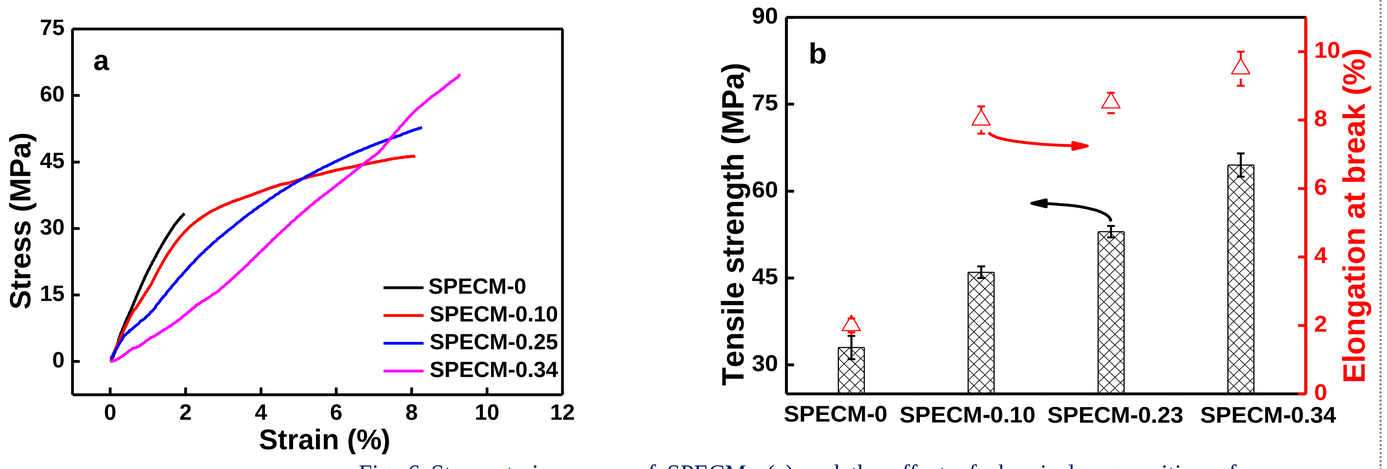

Fig. 6 Stress-strain curves of SPECMs (a) and the effect of chemical composition of SPECMs on the tensile strength and elongation at break (b)

Conclusions

- Synthesis of a novel SPEC and its SPECMs using dual anionic copolymers containing COO^- and SO_3^-.
- SPECMs containing SO_3 groups exhibited better stability and PV performance.
- SPECMs mechanical property was enhanced by incorporating strong ion-pairs.

Ackowledgements

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References

1. Y. Jang, B. Akgum, H. Kim, etc., Char, *Macromolecules* 2012, 45, 3542-3549.
2. X.S. Wang, Q.F. An, Q. Zhao, etc., *J. Membr. Sci.* 2013, 435, 71-79.