Facile Poly(ethyl-ketone) Chemical Functionalization for Anion Exchange Membranes

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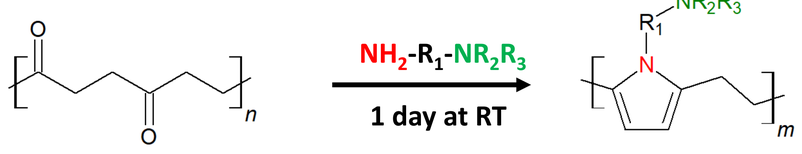
Introduction

Green hydrogen will play a central role in achieving carbon neutrality by 2050 as targeted by the new European Climate Law. Anion Exchange Membrane Electrolyzers (AEMWE) promise a drastic price reduction of green hydrogen by displacing expensive Pt-group metal electrocatalysts. However, the alkaline stability of the polymeric anion exchange membrane (AEM) still remains a major bottleneck for the commercialization of this technology.

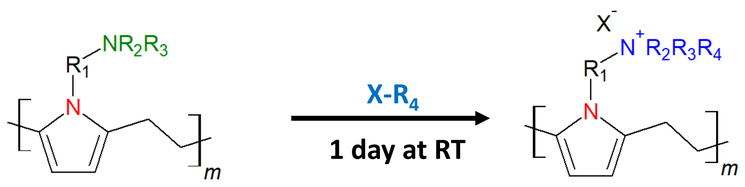
To improve the stability of AEMs, the polymers must show high mechanical stability and chemical resistance while simultaneously preserving high ionic conductivity and ion exchange capacity (IEC).

Synthesis

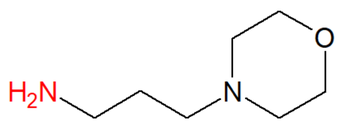
Pall-Knorr reaction



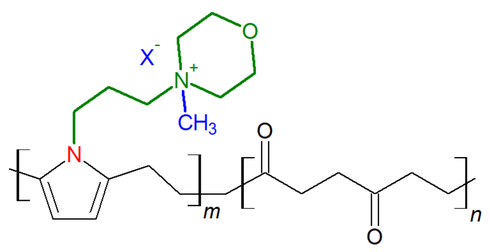
Alkylation



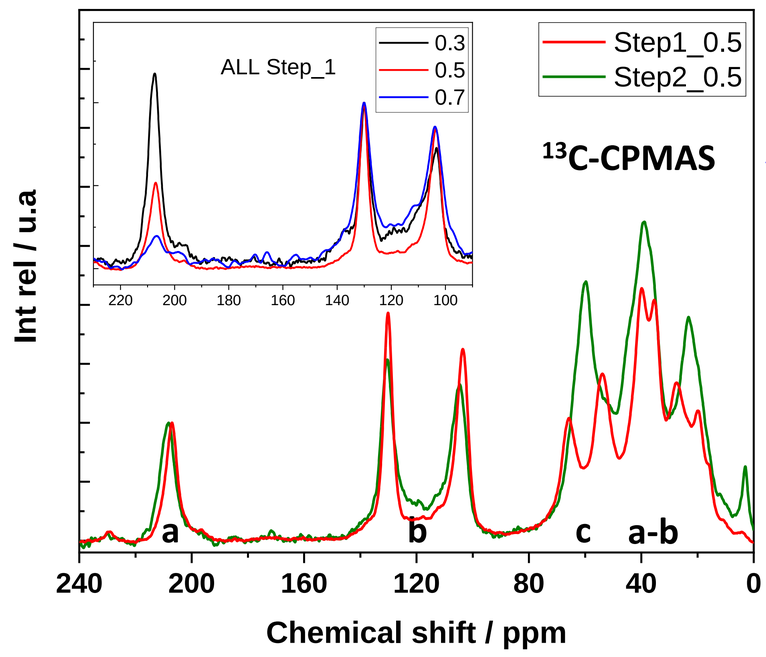
Diamine used/Final product

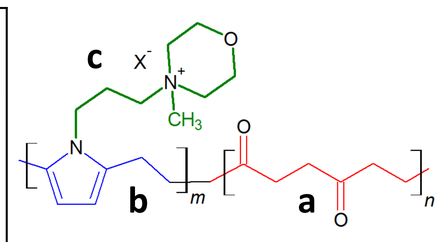


N-(3-Aminopropyl)morpholine



ssNMR investigation

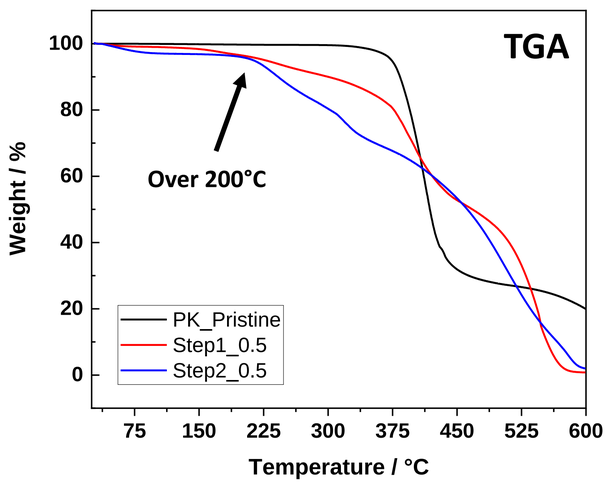


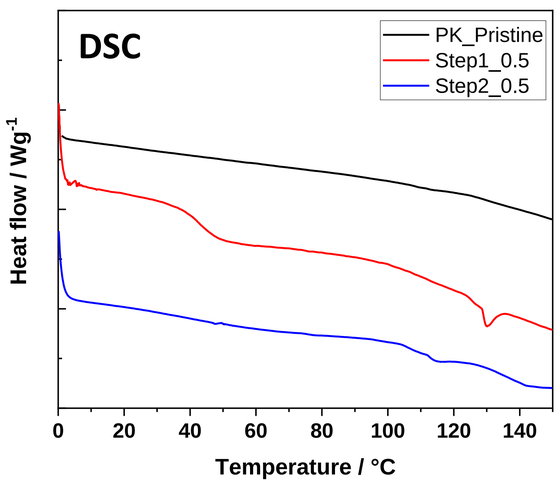


Degree of functionalization

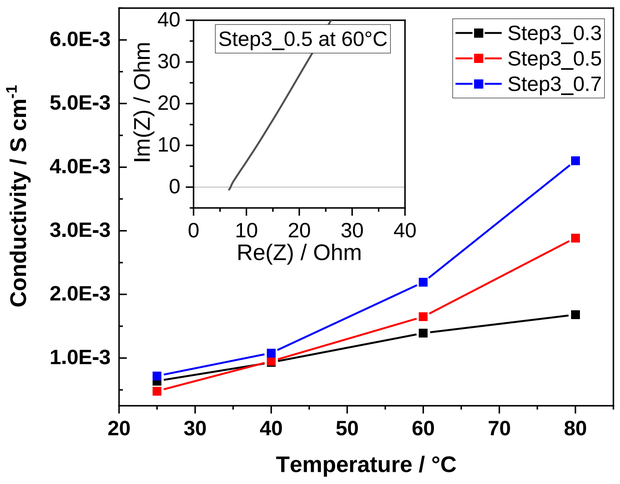
	Yield (%)
Step1_0.3	27,2
Step1_0.5	32,5
Step1_0.7	58,0

Thermal Analysis





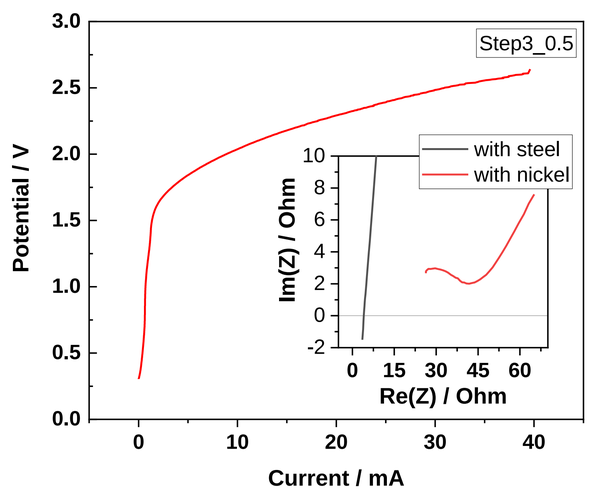
Conductivity and IEC



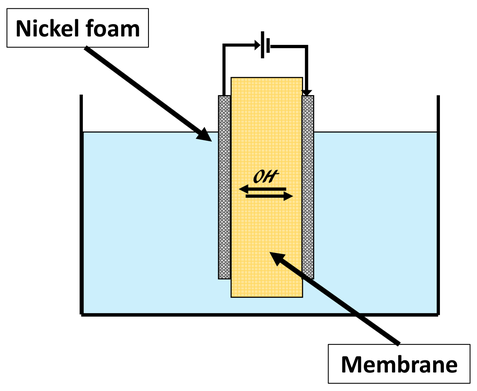
EIS measurements in pure water

	IEC (meq*g^{-1})	Yield$_{(tot)}$ (%)
Step3_0.3	1.48	23.6
Step3_0.5	1.74	33.3
Step3_0.7	2.24	49.9

Preliminary test



Polarization curve in pure water



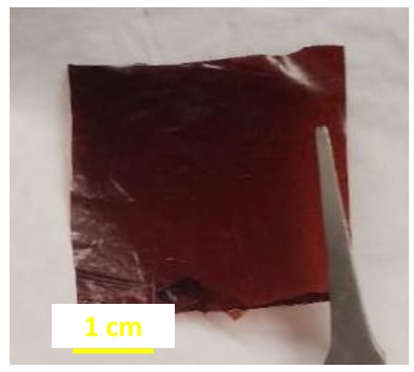
Highlights

Synthesis advantages

- Low-cost materials
- Few steps / mild condition

Membranes features

- Minimum thickness 30 µm
- Reduced water swelling



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References:

1. Zhou, Y. C. et al., J. Mater. Chem. A 9, 14827–14840 (2021)
2. Samples, E. et al., Macromolecules 51, 9323–9332 (2018)
3. Nozaki, K. & Ito, S. Polymer Science: A Comprehensive Reference, 10 Volume Set vol. 3 (Elsevier B.V., 2012)

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