Self-Healing Single-Ion Conducting Triblock Copolymer Electrolytes for Sodium Batteries via RAFT Polymerization

Yuxuan Zhang[1], Mokun Chen[2], Théophile Pelras[2], Katja Loos[2], Giuseppe Portale[1]

1.Physical Chemistry of Polymeric and Nanostructured Materials, Zernike Institute for Advanced Materials, University of Groningen
2.Macromolecular Chemistry and New Polymeric Materials, Zernike Institute for Advanced Materials, University of Groningen

university of groningen
faculty of science and engineering
zernike institute for advanced materials

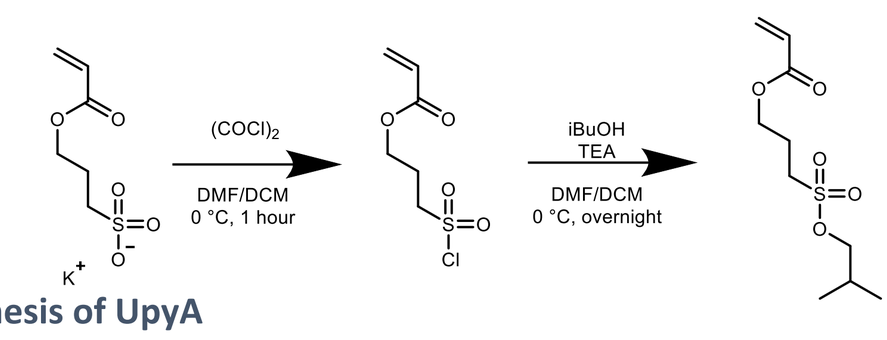
INTRODUCTION AND AIM

Sodium metal batteries (SMBs) offer a promising alternative to lithium-ion batteries due to sodium's abundance and cost-effectiveness [1]. However, the formation of sodium dendrites and limited ion transport efficiency in polymer electrolytes hinder their commercial viability [2].

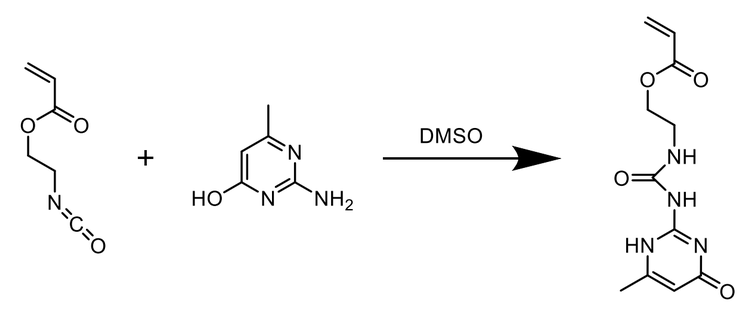
To address these challenges, a type of self-healing single-ion conducting polymer electrolyte (SICPE) has been designed via reversible addition–fragmentation chain transfer (RAFT) polymerization [3]. The electrolyte is based on an A–B–C triblock copolymer architecture comprising three distinct functional blocks. **The self-assembly of the triblock copolymer leads to microphase separation, forming continuous, high-speed ion conduction channels and achieving high ionic conductivity** [4]. The single-ion conduction eliminates anion polarization, homogenizing Na^+ flux to suppress dendrite nucleation [5]. This design effectively mitigates sodium dendrite growth while ensuring mechanical stability and extended cycle life for SMBs.

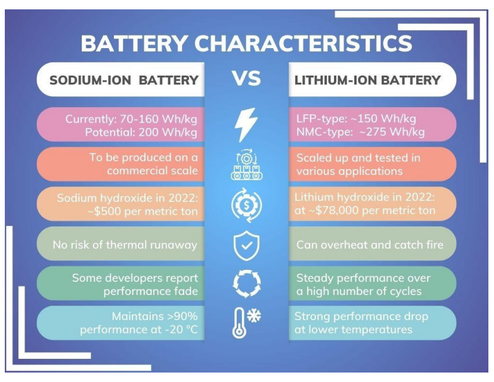
SYNTHESIS OF MONOMERS

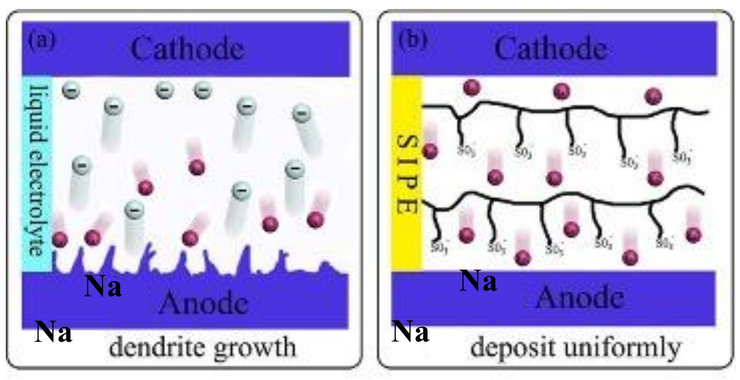
Synthesis of PBSPA

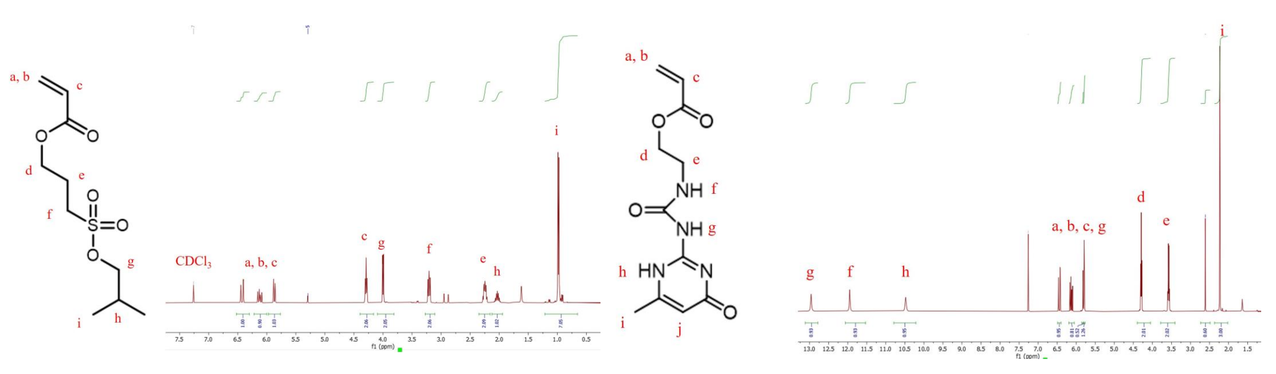


Synthesis of UpyA



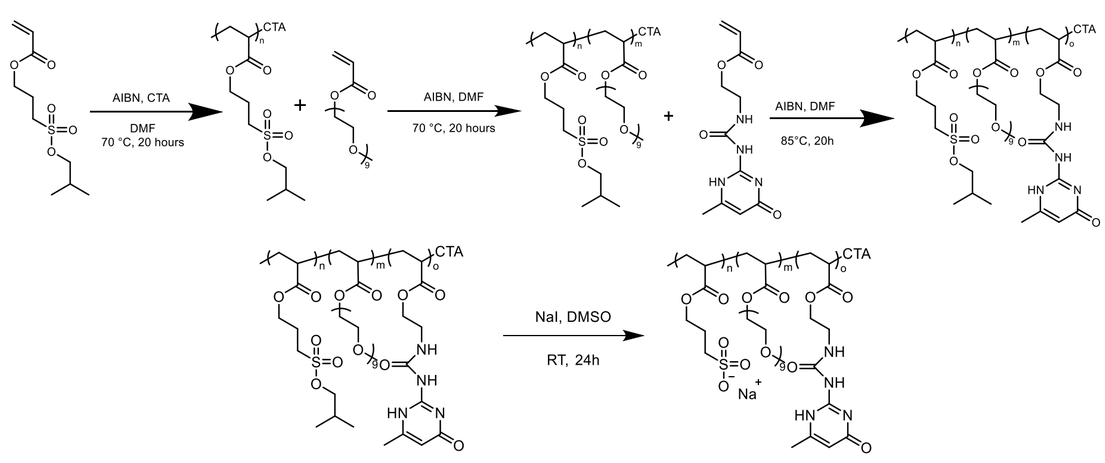




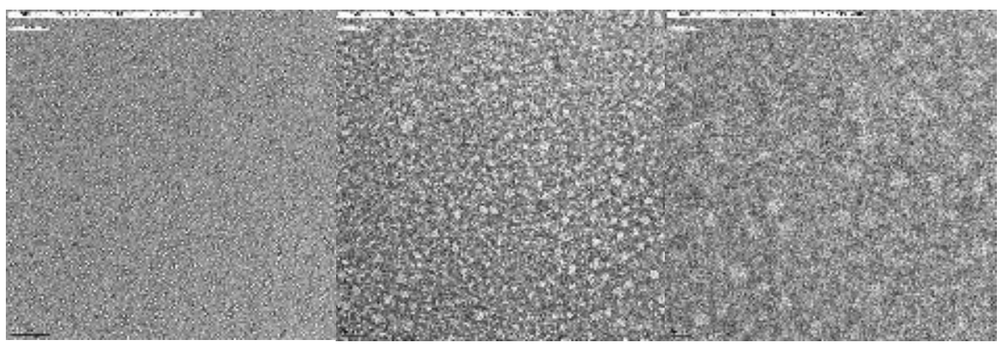


SYNTHESIS AND CHARACTERIZATION OF POLYMER ELECTROLYTES

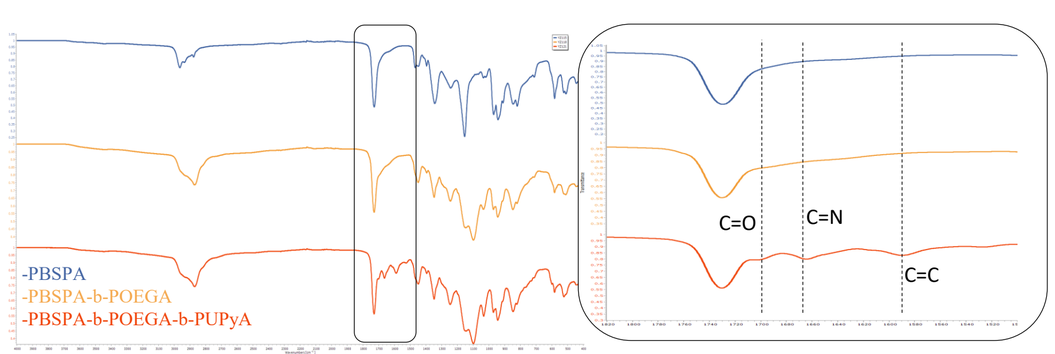
(A) Synthesis of SICPEs

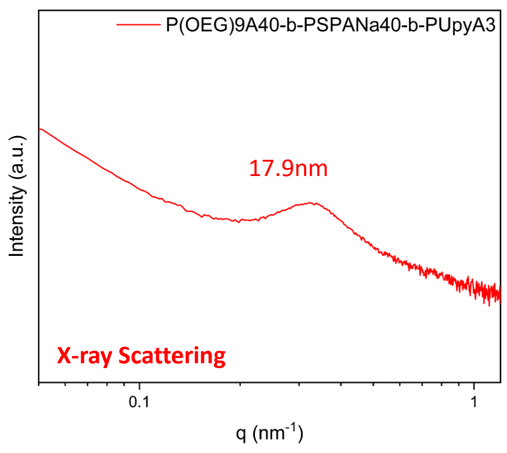


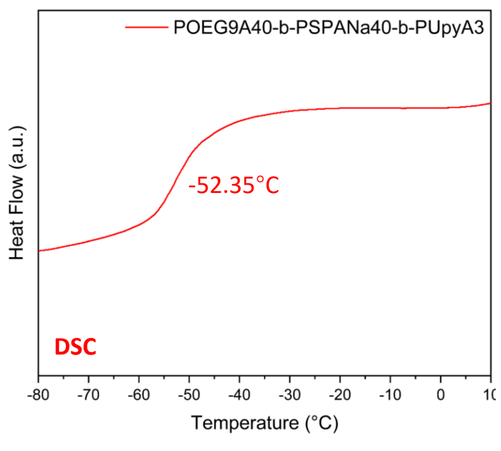
(B) Transmission Electron Microscopy

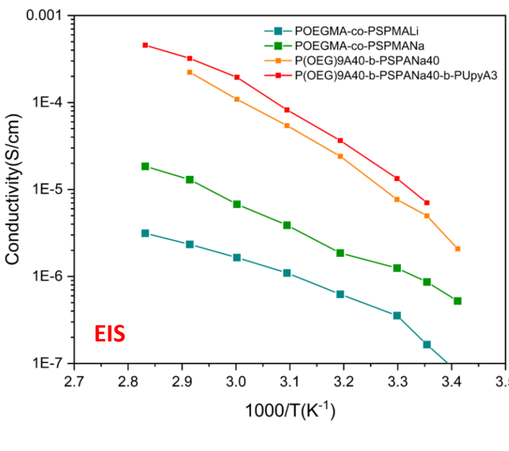


(C) Characterization of SICPEs









CONCLUSIONS AND FUTURE WORK

Two specific monomers have been successfully synthesized to introduce different properties.

Single-ion conducting triblock copolymer electrolytes have been successfully synthesized.

The ionic conductivity of the SICPE is 9.34×10^{-6} S/cm at 30 °C.

Outlook

Assemble sodium-ion/metal full cells and evaluate electrochemical performance

Establish structure-property relationships between ionic conductivity and microphase separation behavior

Correlate mechanical strength with morphological evolution of SICPEs

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Yuxuan ZHANG

sites.google.com/rug.nl/portale-lab/
y.z.zhang@rug.nl

rijksuniversiteit groningen

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