Porous (S)PSf membranes for pH-neutral, aqueous organic flow batteries

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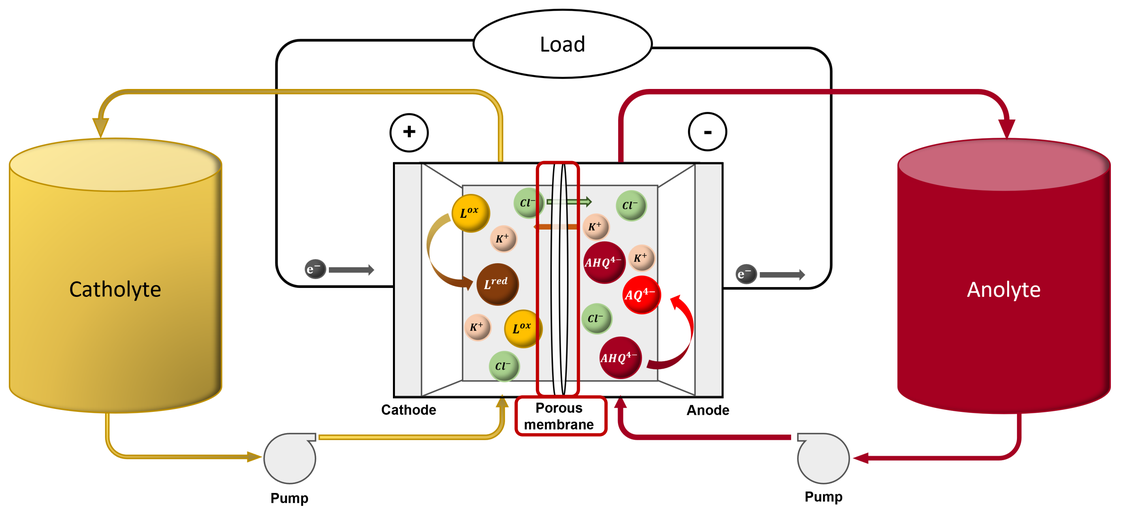
The **membrane** is a crucial component in aqueous organic flow batteries and must fulfill several requirements:

- ✓ High ionic conductivity
- ✓ Low permeability
- ✓ High chemical and mechanical stability
- ✓ Low cost

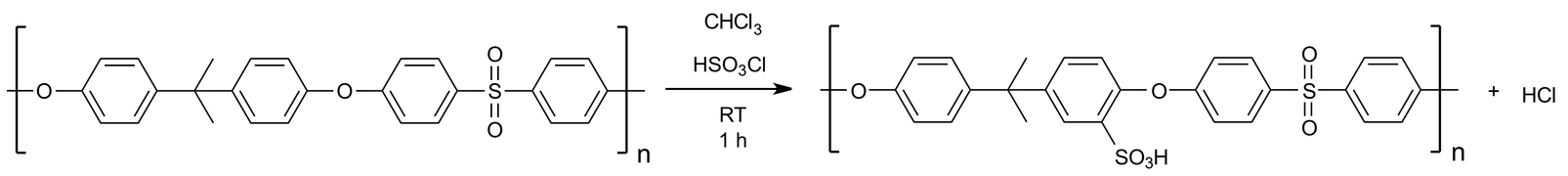
Commonly used ion exchange membranes might not properly fulfill these criteria. Instead, **inexpensive porous membranes** can replace them when combined with large organic compounds.

In **this research**, several porous (S)PSf membranes were prepared via non-solvent induced phase separation (NIPS) and their ionic conductivity and permeability towards organic compounds were determined.



Visual representation of a pH-neutral, aqueous organic flow battery.

1) Sulfonation of PSf



2) NIPS

Dissolving polymer in solvent

Casting of film

Immersion in water bath

Series 1: Porosity variation

PSf in TamiSolve: 14, 16, 18, 20 wt% PSf in dope solution

Series 2: Charge density variation

16 wt% PSf/SPSf blend in TamiSolve: 0, 5, 10, 15 wt% SPSf in blend

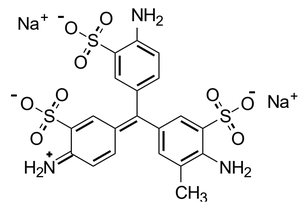
Observation

Brittleness increases upon increased SPSf content.

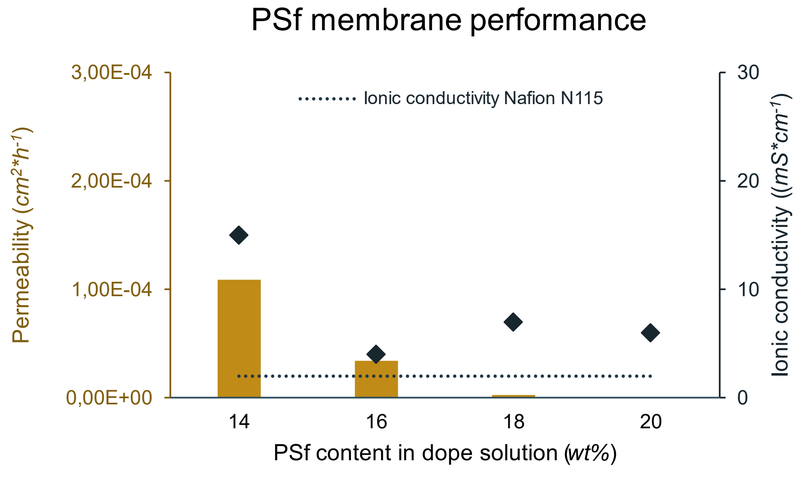
Permeability measurements: Acid Fuchsin as probe molecule (M_W = 586 g*mol^{-1})

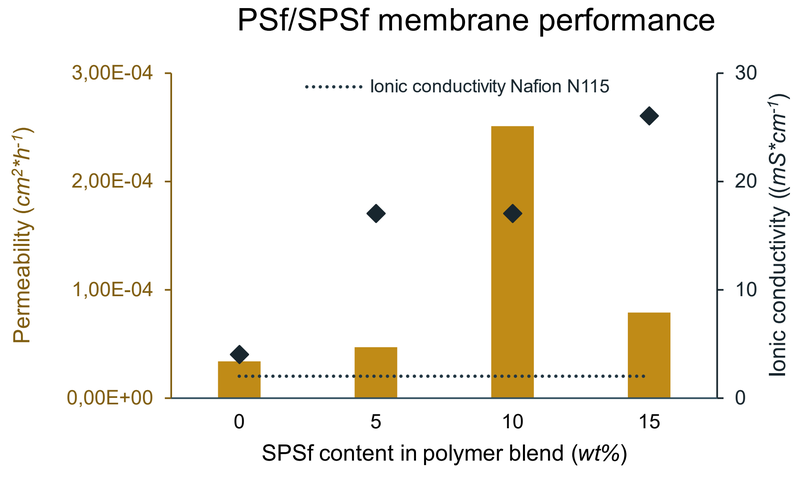
No observed diffusion through Nafion N115 and PSf-20 after 4 days of measurement

Ionic conductivity (in 1 M KCl): All (S)PSf membranes outperform Nafion N115 with respect to conductivity



Acid Fuchsin.





- All porous (S)PSf membranes had a higher conductivity than Nafion N115 in 1 M KCl.
- Increasing porosity results in conductivity enhancement, but at the cost of a higher dye permeability. Tuning organic redox compounds so that they can be combined with porous membranes is thus indeed an interesting strategy.
- Introduction of SPSf in the membrane also serves as a way toward conductivity enhancement, but is only viable for low SPSf contents, since this also results in membranes with deteriorated mechanical stability and increased permeability.

Acknowledgements

Jannes Deprez is grateful for his FWO-SB fellowship (1S15323N).