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Sulfonated Poly(Arylene Thioether Sulfone) Cation Exchange Membranes with Improved Permselectivity/Ion Conductivity Trade-Off

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ABSTRACT

This study shows how the membrane morphology can be optimized to improve the trade-off between membrane permselectivity and ion conductivity which are the primary parameters determining the goodness of a membrane for electrochemical applications. In particular the attention is here focused on the electrochemical transport properties at highly concentrated solutions (up to 8 M LiCl) which are particularly challenging for the membranes' performances. To this end sulfonated poly(arylene thioether sulfone) (SPTES) membranes with different characteristics of the nanoscopic pore network have been synthetized by varying the copolymer composition. It is shown how the relatively high-charged SPTES membranes with low swelling degree have overlapping electrical double layers even at electrolyte concentrations above 2 M. This ultimately results in permselectivities close to the maximum theoretical ones predicted by the modelling of highly charged nanopores. Yet these membranes retain high ion conductivity similar to the *state-of-art* cation exchange membranes with considerably lower permselectivity. Chemical stability in acidic (4 M) and vanadium oxidative environments show no degradation over time and together these results show that SPTES membranes with optimized morphology are promising for several electrochemical applications such as flow batteries.

Graphical Abstract