High proton permselective pore-filling membranes for vanadium redox flow batteries

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Novel proton permselective pore-filling membranes with low vanadium co-ion crossover were developed for the application to a vanadium redox flow battery. The proton permselective polymer electrolytes consisting of the whole hydrocarbon materials were introduced into porous hydrocarbon substrates and crosslink-polymerized by radical polymerization in this work. The thickness of the prepared membranes was controlled between 20 and 25 micrometers to extremely lower membrane resistances. Finally, film-like polymer electrolyte membranes were prepared. The prepared pore-filling membranes are able to drastically decrease vanadium co-ion crossover through the membrane because the porous substrate suppresses a swelling factor of highly functionalized electrolytes in water media such as liquid phase operation conditions. The physico-chemical properties of the prepared membranes such as swelling behavior, ion exchange capacity, vanadium co-ion crossover, and ionic conductivity were investigated in correlation with the electrolyte composition. Also the thermal and the structural property of the prepared pore-filling membranes were evaluated by TG-DTA and SEM.