

Tailoring SPEEK/SPVdF-co-HFP/La₂Zr₂O₇ ternary composite membrane for cations exchange membrane fuel cells

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Synthesis of SPEEK

The received PEEK powders are originally heated in an oven at 80° C to evaporate the water molecules. The electrophilic substitution of the sulfonic acid group in PEEK (5g) was made by the 75ml of concentrated sulfuric acid under room temperature condition. After the ample timing (7 hours) for homogeneous mixing was fulfilled then the reaction is terminated using the adding of cold de-ionized water. Besides, essential of neutral P^H of the polymer solution was required the solution was washed several times and finally collects the precipitation. The wet polymer precipitations were dried overnight with the 60° C temperature. The degree of sulfonation of polymer was attained 66.52% confirmed using NMR tool.

Formulas for water uptake parameters, IEC and hydration no 'λ'.

$$\text{Weight change \%} = \frac{(W_{\text{wet}}) - (W_{\text{dry}})}{(W_{\text{dry}})} \times 100 \quad (1)$$

$$\text{Thickness change \%} = \frac{(S_{\text{wet}}) - (S_{\text{dry}})}{(S_{\text{dry}})} \times 100 \quad (2)$$

$$\text{Length change \%} = \frac{(L_{\text{wet}}) - (L_{\text{dry}})}{(L_{\text{dry}})} \times 100 \quad (3)$$

W_{dry} , W_{wet} , S_{wet} , S_{dry} , L_{wet} , L_{dry} are measured weight (mg), thickness (mm) and length (mm) of dry and wet samples.

$$\text{Ion Exchange Capacity} = \frac{V_{\text{NaOH}} \times N_{\text{NaOH}}}{\text{Dry weight of the membrane}} \quad (\text{meqg}^{-1}) \quad (4)$$

$$\lambda = \left(\frac{\text{water uptake value}}{18.01} \right) \left(\frac{10}{\text{ion exchange capacity}} \right) \quad (5)$$