

Improving the stability and performance of radiation-induced grafted high-density polyethylene-based anion-exchange membranes by the controlling irradiation conditions

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The preparation of anion-exchange membranes (AEM) with high stability for electrochemical devices as fuel cells is current challenge [1]. Here, a series of anion-exchange membranes based on high-density polyethylene (HDPE) were prepared by radiation-induced grafting technique under different pre-irradiation conditions such as irradiation dose, temperature (low temperature (LT) and room temperature (RT)), and atmosphere (nitrogen and air). HDPE has been considered as a promising base polymer for AMs due to its high resistance to radiation, chemical and thermal stability, and satisfactory mechanical properties. It was elucidated that the pre-irradiation parameters can affect the microstructure of AEMs and consequently their properties [2]. AEMs were characterized in terms of degree of grafting (DoG), ions exchange capacity (IEC), water uptake (WU), FT-Raman, tensile test, hydroxide conductivity, begging-of-life fuel cell test and short-term stability. A parallel between the RT-air and LT-air samples shows very well as irradiation conditions affect significantly the AEM properties. As an example, the irradiation temperature influences the DoG leading to an increase in DoG by 30% for AEM pre-irradiated at LT. The begging-of-life fuel cell performances at 80 °C were found to be enhanced for LT pre-irradiated HDPE-based AEM (2.1 W cm⁻²). Short-term stability (80°C, RH = 80%) for RT-air and LT-air samples exhibited rates of 0.17 and 0.06 % h⁻¹. Hence, the present study advances the understanding of the role played by the irradiation process on the final properties of radiation-induced grafted HDPE-based AEMs and offers new possibilities to guide future developments in anion-exchange membranes synthesis.

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