

Impact of Sulfonated Poly(Ether Ether Ketone) pretreatments on Proton Exchange Membrane Fuel Cells performances

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Many works have been devoted to the development of low cost ionomers as alternative to perfluorosulfonic acid membranes for Proton Exchange Membrane Fuel Cells (PEMFC) applications. Among them, sulfonated Poly(Ether Ether Ketone) (sPEEK) membranes. Before use, sPEEK membranes must be pretreated to ensure a complete protonic substitution and removal of residual reagents/solvent. This is generally ensured by soaking the membrane in an acid solution -at room temperature or higher, usually at 80°C¹- followed by a rinsing step in water at room temperature. In addition to these pretreatment steps, it was reported² that an hydrothermal treatment in water at high temperature for a few hours to a few days can improve the membrane nanostructure, water uptake and proton conductivity with expected positive effects on performances. Herein, we studied the impact of sPEEK membrane pretreatment on fuel cell performances using two different batches of Fumapem E730 from Fumatech, acquired in 2019 and in 2020. Five different protocols were tested. The first consists only in membrane acidification and rinsing, while the four others also include a hydrothermal treatment in water at 80°C from 1 hour to 72 hours, and possibly an additional hydro alcoholic treatment. The 2020 batch membranes subjected to a hydro alcoholic pretreatment followed by a 72-hours hydrothermal pretreatment achieved the best performances and the lowest high frequency resistance (R_{hf}) when tested in a fuel cell. Their performances even exceeded those of a Nafion XL membrane. This could be explained by a better ionomer nano-structuration and therefore a better protonic conductivity. These performances will be compared to those of the 2019 batch.

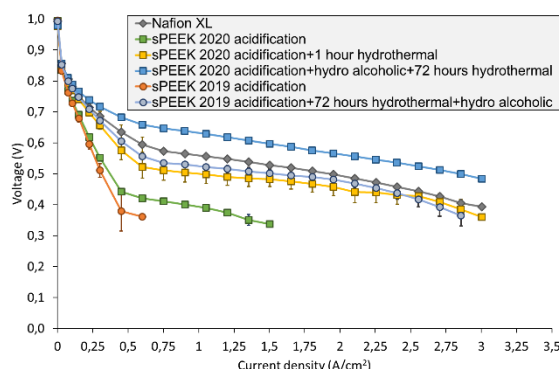


Figure 1: O₂/H₂ polarization curves of sPEEK membranes with various pretreatments and comparison with Nafion XL.

References:

- (1) Jun, M.-S.; Choi, Y.-W.; Kim, J.-D.. *J. Membr. Sci.* **2012**, 396, 32–37. <https://doi.org/10.1016/j.memsci.2011.12.008>.
- (2) Mendil-Jakani, H.; Zamanillo López, I.; Mareau, V. H.; Gonon, L. *Phys. Chem. Chem. Phys.* **2017**, 19 (24), 16013–16022. <https://doi.org/10.1039/C7CP00087A>.