Pre-Stretched Low Equivalent Weight PFSA Membranes with Improved Fuel Cell Performance - DTU Orbit (18/11/2019)

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Uniaxial stretching of recast perfluorsulfonic acid (PFSA) films was used to promote desirable morphological changes for 3M Company's 825 equivalent weight (EW) and 733 EW PFSA polymers. Stretching to a draw ratio (DR) of four was followed by a high temperature annealing step in order for the morphological changes to be permanent. For 825 EW PFSA, stretching increased the polymer crystallinity by 22.5%, with a reduction in methanol permeability and a small increase in proton conductivity. In direct methanol fuel cell tests at 60 °C with 1.0 M methanol, the power density at 0.4 V with a DR = 4 stretched 825 EW membrane (72 mW/cm²) was considerably greater than that obtained with a solution-cast membrane (28 mW/cm²) or with a commercial Nafion 117 membrane (55 mW/cm²). For 733 EW PFSA, stretching promoted the formation of ordered ionic domains leading to an increase in proton conductivity. There was also a substantial increase in the polymer's α-transition temperature and an improvement in membrane mechanical properties after stretching. The lifetime of a stretched 733 EW PFSA membrane (DR = 4) was extended by a factor of 3.5 as compared to that of a solution-cast film in an open circuit voltage humidity cycling test at 80 °C. © 2014 The Electrochemical Society

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