

Structure and Transport Properties of Annealed Nafion Membranes

Bruno R. Matos¹, Jaqueline de Souza da Silva¹, Fábio Coral Fonseca¹

¹Instituto de Pesquisas Energéticas e Nucleares

e-mail: brmatos@ipen.br

The relationship between electrical properties and the structural features of annealed Nafion samples was investigated by X-ray diffraction (XRD), small angle X-ray scattering (SAXS), scanning electron microscopy (SEM), and impedance spectroscopy. Understanding of the observed effects on the proton conductivity due to annealing at controlled humidity at high temperature is crucial for improving the polymer electrolyte fuel cell (PEFC) at high operating temperatures ($T > 100$ °C) [1]. The experimental results reveal that membranes submitted to a heat treatment in the 100 - 200 °C temperature interval at low relative humidity (RH), display higher crystallinity and irreversibly shrinking of the ionic domains. However, the electrical properties of the polymer matrix were mostly affected by the irreversible destabilization of the ionic phase. The increase in crystallinity and shrinking of the hydrophilic domains reduce the ionomer conductivity. These features were reflected in the polymer electrolyte fuel cell (PEFC) tests in which the measured performance was lower for Nafion samples annealed at high T compared to pristine membranes. Such results are relevant for the preparation of membrane electrode assemblies as well as for the development of high-performance ionomer membranes.

Acknowledgements

Thanks are due to the Brazilian funding agencies (CAPES, CNPQ, FAPESP 2013/50151-5) and to CNEN.

References

[1] A. C. C. Yang, R. Narimani, B. J. Frisken, S. Holdcroft, J. Mem. Sci. 469, 251 (2014).