

# Sublayered Structures of Thin Films of Hydrated Nafion and Anion Exchange Ionomers Cast on Pt Substrates Analyzed by Neutron Reflectometry under Controlled Temperature and Humidity

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The confirmations of ionomers as well as the distribution of water therein are important for AEMFCs as well as PEMFCs. For a deeper understanding of the in-plane water distribution, neutron reflectometry (NR) at the temperature of 60 °C and the relative humidity (RH) of 0 - 90% was carried out on thin films of Nafion and a newly-synthesized anion exchange ionomer, BAF-QAF (Fig. 1), with a thickness of approximately 150 and 60 nm, respectively, cast on 20-nm Pt layers deposited on SiO<sub>2</sub>/Si(100) [1]. Clear NR modulations were obtained under all conditions on both ionomer films (Fig. 2). NR data were fit very well with a 3-sublayered model parallel to the substrates. The densities of ionomers (Nafion and BAF-QAF) and water (H<sub>2</sub>O and D<sub>2</sub>O, respectively) were calculated at all sublayer under different conditions with a method previously reported [2]. For both ionomers, the sublayers attached to Pt showed hydrophobicity, and the interfacial sublayer of BAF-QAF/Pt showed was extremely hydrophobic. The sublayer structures are discussed with respect to the membranes and binders used in FCs.

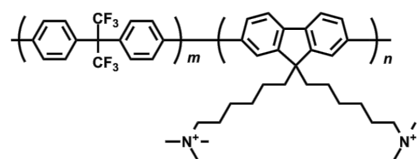


Fig. 1 Chemical structure of BAF-QAF.

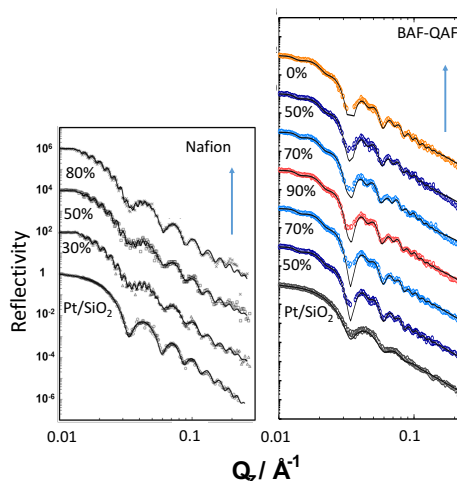


Fig. 2 NR modulations of Nafion/Pt/SiO<sub>2</sub>/Si(100) and BAF-QAF/Pt/SiO<sub>2</sub>/Si(100) at 60 °C at different humidities under N<sub>2</sub> humidified by D<sub>2</sub>O and H<sub>2</sub>O, respectively.

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## References:

- [1] T. Kawamoto et al., *Electrochemistry*, **87**, 270 (2019).
- [2] T. Kawamoto et al., *Jpn. J. Appl. Phys.*, **58**, SIID01 (2019).