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Resonant Soft X-Ray Scattering for the Multimodal Operando Characterization of Proton Exchange Membranes ISVAR CORDOVA, GREGORY SU, DAVID KILCOYNE, AHMET KUSOGLU, ADAM WEBER, CHENG WANG, Lawrence Berkeley Natl Lab — The design of novel high-performance membranes for electrochemical applications relies on our ability to elucidate the relationships between their nanometer-scale chemistry, physical structure, and function. Our study harnesses the spatio-chemical sensitivity that is inherent to Resonant Soft X-ray Scattering (RSoXS) to characterize the proton exchange membrane component of a custom fuel/electrolytic cell under operando conditions, while also facilitating complementary studies with other spectromicroscopic methods. In this presentation, we will present recent results on Nafion, a membrane material that is considered to be a critical cost and performance-limiting component in many electrochemical devices. Recent RSoXS results acquired with a wet sample cell interrogated the Nafion films' partially orientated molecules inside ionomer domains. Using polarized X-rays tuned to the fluorine absorption edge, we observed a strong scattering anisotropy that indicated preferred local crystalline grain orientation at the interface between different phases. We will then expand on how combining such operando RSoXS data with other analytical methods can uncover important dynamic structure-property relationships underlying the interplay of various critical performance factors.

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