ASYMMETRICALLY REINFORCED MEMBRANES FOR ANION EXCHANGE MEMBRANE FUEL CELL

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Summary: Anion Exchange Membrane Fuel Cells (AEMFCs) is promising for the generation of electric power from hydrogen, with the expected possible replacement of precious metal catalysts by Earth abundant ones.[1-2] Beyond the independent properties of core materials (AEM, anode and cathode catalysts), the water management during operation is key to achieving high power density, but also high longevity due to the strong sensitivity of AEMFC performance to anode flooding on one hand, and strong sensitivity of AEM's durability to incomplete humidification on the other hand. Thin AEMs are critical to achieve high AEMFC power performance, as the back-diffusion of water from anode to cathode critically helps to mitigate anode flooding. [3] Due to the high swelling of hydrated AEMs, good mechanical durability of thin AEMs however typically requires the introduction of a reinforcement, often a porous polytetrafluoroethylene membrane filled with the anion exchange ionomer.

Here, we investigated the structure of different commercial AEMs and their behavior in operating AEMFC. We identified that the position of the reinforced PTFE layer strongly differs from one type of AEM to another. In the case of strongly asymmetric through-plane position of the PTFE layer (Fig. 1a), the positioning of the PTFE reinforcement close to the anode or close the cathode has a significant impact on initial power performance (Fig. 1b). A better performance and improved stability was observed with the PTFE layer close to the anode, suggesting the asymmetric structure can improve the water management in such configuration. The presentation will discuss the results obtained on different commercial AEMs, and whether the asymmetric structure of AEM can be combined with PTFE hydrophobized anodes for even improved performance. The results shed light on the importance of identifying the position of PTFE reinforcement in commercial or in-house AEM for AEMFC application, with potential implications also for AEM electrolyzers or water-CO_2 co-electrolyzers.

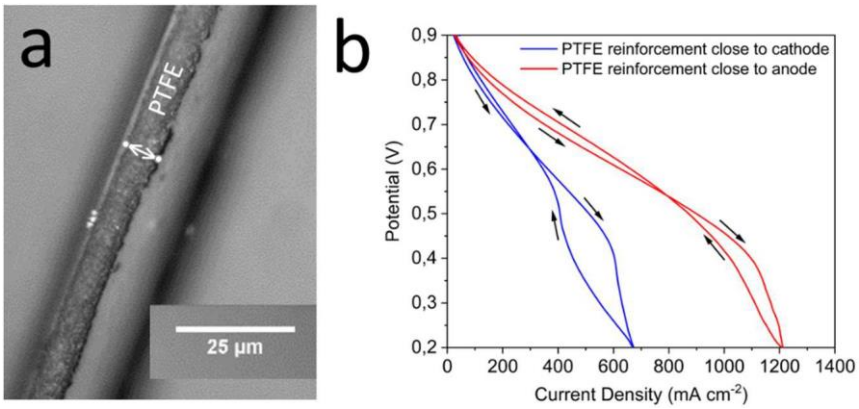

Fig. 1 Position of the PTFE reinforcement and its effect in AEMFC. a. Cross-section showing the AEM structure, b. initial AEMFC performance with PTFE reinforcement close to anode (red curve) or to cathode (blue curve). PtRu/C anode, FeNC cathode, Pention 20 µm AEM.

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