ANION EXCHANGE MEMBRANE FUEL CELLS:

High power combination

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Anion exchange membrane (AEM) fuel cells are an attractive alternative to proton exchange membrane fuel cells because they operate in high pH environments, which means that cheaper, non-platinum catalysts can be used for oxygen reduction at the cathode. The development of AEMs, however, remains challenging. The main issues are their low ionic conductivity, high water uptake (and thus swelling and softening of AEMs) and poor chemical and mechanical stability. Now, Paul Kohl and colleagues in the USA develop a composite AEM based on block copolymers of poly(norbornene), simultaneously achieving high power, durability and efficient water management in a fuel cell device.

Conventional polymer-structured AEMs often suffer from excessive water uptake due to high humidity levels during operation; cross-linked polymer networks could avoid high water uptake, but the mobility of hydroxide ions may also be reduced. In addition to the mobility of ions, ion-exchange capacity (IEC) is another factor that determines the ionic conductivity. While the ionic conductivity typically scales with the IEC, a higher IEC could lead to a higher water uptake. Building on their previous works on AEM development, the researchers synthesize cross-linked tetrablock poly(norbornene) membranes to tackle these conundrums. The block copolymer has a high IEC, but the light cross-linker (*N,N,N',N'*-tetramethyl-1,6-hexanediamine) is able to mitigate excessive water uptake. The copolymer also features quaternary ammonium head groups that are known to be for good alkaline stability. A polytetrafluoroethylene reinforcement layer in the membrane provides extra mechanical strength. The combination of these components in the AEM leads to a peak power density of 3.4 W cm^{-2} at 80°C , which is reported to be 70% higher than the previous record for H_2/O_2 AEM fuel cells, and a fairly stable run over 500 hours.

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