Blend membranes of polybenzimidazole and an anion exchange ionomer (FAA3) for alkaline water electrolysis: Improved alkaline stability and conductivity

Anion exchange membranes (AEMs) conduct selectively hydroxide ions, while KOH doped polybenzimidazole is an ion-solvating polymer, conducting both potassium and hydroxide ions. In this work, meta-polybenzimidazole (mPBI) was blended with FAA3, a commercially available AEM, in the ratios of 2:1, 3:1, 4:1, 5:1 and 1:0. Doping was done by immersion in 0, 10, 15, 20, 25 and 30 wt% KOH solutions, giving rise to 30 membranes which were analyzed for their swelling behavior during doping, their composition (polymer, water, KOH), their mechanical properties and their through-plane conductivity in KOH solutions. Especially PF-41 showed higher tensile strength and Young's modulus than mPBI under all tested KOH concentrations. The highest conductivity of 166 mS cm⁻¹ was observed for PF-51 doped in 25% KOH, 80% higher than for mPBI. In an alkaline stability test, blend membranes showed higher tensile strength, Young's modulus and lower weight loss than mPBI after 4 weeks at 85 °C in 25 wt% KOH solution. PF-31 and PF-41 were also tested in an electrolysis cell, where they showed cell resistance comparable to mPBI. Because systems without cathode feed can be quite efficient, the permeability of membranes for KOH solutions was investigated.