Nafion-Azole-H_3PO_4 Composite Membranes using Solution Processing for High Temperature PEMFCs

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High-temperature polymer electrolyte membrane fuel cells (PEMFCs > 120°C) have been attracting attention because of certain advantages, such as improved tolerance of the Pt electrodes to carbon monoxide (> 1 % CO at 150°C), performance relatively independent of humidity, cathode kinetics enhanced by higher temperatures, simple system, and effectiveness of the cogeneration of water, heat, and electricity [1].

Electrolyte membranes with alternative chemistries that are tolerant to high temperatures (100 – 200°C) have been investigated, such as perfluorinated ionomers and their composites (H_3PO_4, heteropolyacid, silica, zirconium phosphate, TiO_2, imidazole/H_3PO_4, benzimidazole, 1,2,4-triazole and 1,2,3-triazole), hydrocarbon polymer membranes such as sulfonated poly(ether ether ketone) (SPEEK), polybezimidazole (PBI), poly(2,5-benzimidazole) (ABPBI), organic-inorganic blend membranes, and 1,2,3-triazole derivatives.

We have been studied on the acid-base composite membranes using Nafion solution and azole group such as imidazole, pyrazole, 1,2,4-triazole, benzimidazole, 1,2,3-triazole as anhydrous electrolytes for the application of high temperature PEMFCs [2-5].

Here, Nafion-azole-H_3PO_4 composite membranes were prepared by autoclave solution processing for high temperature PEMFCs. Azole molecular such as benzimidazole, 1,2,3-triazole, pyrazole, imidazole, 1,2,4-triazole was used as a supporter to make much incorporation of phosphoric acid and homogeneous composite membrane between perfluorosulfonic polymer (Nafion) and phosphoric acid. The Nafion-azole-H_3PO_4 composite membrane was flexible. The conductivity of 0.23 and 0.01 S/cm at the temperature of 150°C, dry was obtained at the Nafion-bz-H_3PO_4 and Nafion-1,2,3-triazole-H_3PO_4 composite membranes, respectively. The cell performance of Nafion-bz-H_3PO_4 composite membrane was higher than that of others.

References

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