

Superhydrophobic Fluorinated Carbons for the Microporous Layer of Polymer Electrolyte Fuel Cells

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論 文 名	Superhydrophobic Fluorinated Carbons for the Microporous Layer of Polymer Electrolyte Fuel Cells (固体高分子形燃料電池に用いるマイクロポーラス層用超疎水性フッ素系炭素材料)
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論 文 審 査 の 結 果 の 要 旨
Thesis Review Result Summary

In this thesis, fluorinated carbon nanoparticles were synthesized using a novel reaction between fluorinated telomers and sodium. The chain length of the fluorinated telomer molecule was varied, resulting in the ability to tailor the fluorine content of the carbons, which ranged from 5.5. to 9.9 at.%. It was found that the water contact angle correlated strongly with the fluorine content. Nitrogen adsorption measurements found that the samples were all non-porous with relatively low surface area ($\sim 25 \text{ m}^2/\text{g}$). X-ray adsorption spectroscopy, Raman spectroscopy and transmission electron microscopy showed that the carbons were highly graphitic. The materials were thermally stable up to $\sim 500 \text{ }^\circ\text{C}$.

The fluorinated carbons were made into microporous layers by blending with PTFE and screen printing onto carbon papers. The porosity, water contact angle, gas permeability and oxygen transport resistance were measured and compared with conventional gas diffusion electrodes. Polymer electrolyte fuel cells were fabricated incorporating the new gas diffusion electrodes, and measured at temperatures of $45 \text{ }^\circ\text{C}$ and $80 \text{ }^\circ\text{C}$ and various values of relative humidity. A clear improvement in voltage was observed especially at high current density. This was attributed to enhanced water removal from the cathode because of the increased hydrophobicity of the fluorinated carbon.

Overall, the examiners found that the thesis was well organized, well written, and comprehensive. The recommendation of the examiners is that the candidate can pass the doctoral defense and graduate.