Electrochemical Impedance Analysis of Biofuel Cell Using MgO-Templated Porous Carbon Electrode

H. Nakafuji[a], Y. Hoshi[a], I. Shitanda[a, b], M. Itagaki[a, b], S. Tsujimura[c]

[a] *Department of Pure and Applied Chemistry, Faculty of Science and Technology, Tokyo University of Science, 2641, Yamazaki, Noda, Chiba 278-8510, Japan*

[b] *Research Institute for Science and Rechnology, Tokyo University of Science, 2641 Yamazaki, Noda, Chiba 278-8510, Japan*

[c] *Division of Materials Sciences, Faculty of Pure and Applied Sciences, University of Tsukuba,1-1-1 Tennodai, Tsukuba, Ibaraki, 305-8573, Japan*

shitanda@rs.noda.tus.ac.jp (I. Shitanda)

Porous carbon materials with having fractal structure, such as carbon cryogel, applied to a biofuel cell for improving the output power.[1] We focused on a MgO-templated carbon as the porous carbon material since the pore size is easy to control.[2] In this study, the authors prepared a biofuel cell using screen-printed MgO-templated porous carbon electrodes. For biofuel cell cathode, a MgO-templated porous carbon powder having 35 nm pore size (Toyo-Tanso) was used throughout. Isophorone, polytetrafluoroethylene, the MgO-templated porous carbon powder and a MgO particle (200 nm diameter) was mixed and then dispersed by using an ultrasound homogenizer. The mixture was printed on a carbon paper surface. Then, the MgO particles in the carbon film were dissolved in 2 M hydrochloric acid solution. Electrochemical measurements were performed in a phosphate buffer solution with three-electrode method. The electrode performance is evaluated by electrochemical impedance spectroscopy (EIS). Electrochemical impedance was measured in the frequency range from 10 mHz to 10 kHz.

Figure 1 shows the impedance spectrum in the high frequency range for MgO-templated porous carbon electrode at -0.1 V. The locus of straight line whose angle is 22.5° against real axis appeared on the Nyquist plots. The present MgO-templated porous carbon electrode has a brunch structure which has composed of macro- and meso pores.[3] In the present study, we investigated the structure of the porous carbon electrode by using a brunch structure transmission line model (Fig. 2). In addition, a bilirubin oxidase (BOD) solution or glucose oxidase solution was dropped on the porous carbon film surface. We prepared biofuel cell using the MgO-templated porous carbon electrodes and investigated its output power under various conditions, such as porous size of macropore and mesopore, amount of MgO-Templated carbon and MgO particle for anode or cathode.

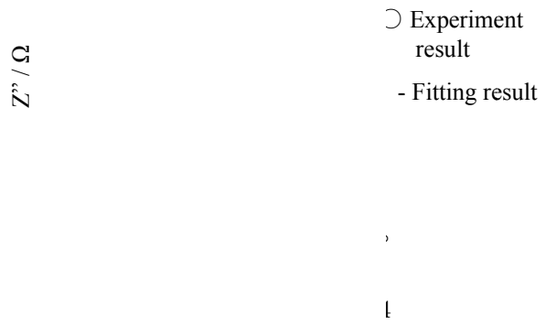

Fig. 1 Impedance spectrum in high frequency range of BFCC(at -0.1V, 200 Hz~1 Hz)

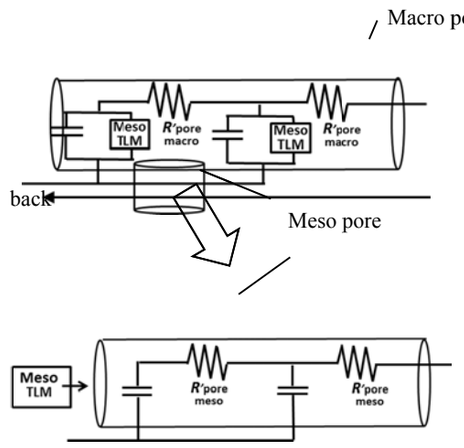

Fig.2 Brunch structure transmission line model

References

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