The 33rd International Korea-Japan Seminar on Ceramics, Daejeon, Korea, Nov. 16-19, 2016.

Performance of Yttria-stabilized Zirconia Fuel Cell using CO–O_2 Gas System and H_2O Gas as an Oxidant

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Abstract

The performance of an yttria-stabilized zirconia fuel cell (YSZ) was examined using CO-O_2 gas system and H_2O oxidant gas.[1] The final target of this research is to establish the combined fuel cell systems which can produce a H_2 fuel and circulate CO_2 gas in the production process of electric power. Fig.1 shows two types of the combined reaction systems for the production of H_2 fuel and the circulation of CO_2 gas in the production process of electric power. A large electric power was measured in the H_2–O_2 gas system and the CO–O_2 gas system at 1073 K (Fig.2). The formation process of O^{2-} ions in the endothermic cathodic reaction ($1/2O_2 + 2e^- \rightarrow O^{2-}$) controlled the cell performance. The CO–H_2O gas system and the H_2–H_2O gas system was expected to produce a H_2 fuel in the cathode ($CO + H_2O \rightarrow H_2 + CO_2$, $H_2 + H_2O \rightarrow H_2 + H_2O$). Although relatively high OCV values (open circuit voltage) were measured in these gas systems, no electric power was measured. At this moment, it was difficult to apply H_2O vapor as an oxidant to the cathodic reaction in a YSZ fuel cell.

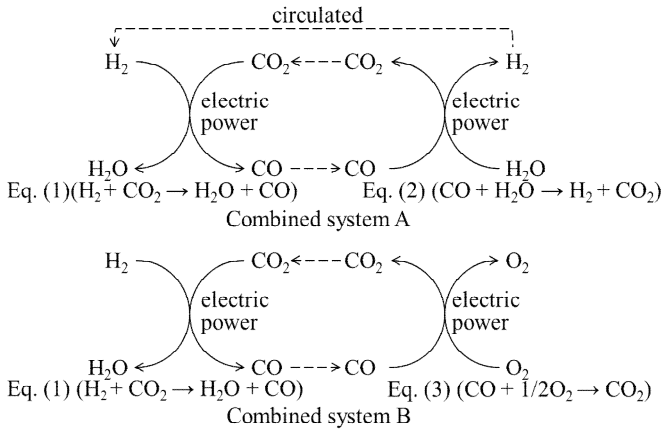

Fig. 1 Combined reaction systems for the production of a H_2 fuel and the circulation of CO_2 gas in the production process of electric power.

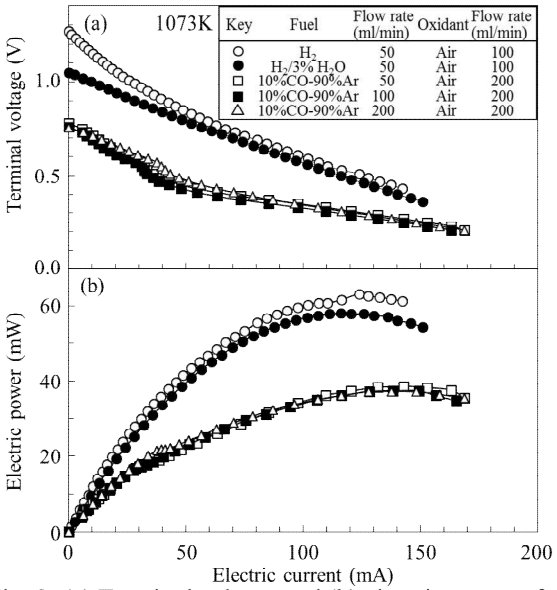

Fig. 2 (a) Terminal voltage and (b) electric power of a YSZ cell using the H_2–O_2 gas system and the CO–O_2 gas system at 1073 K.

References

1) Y. Hirata, S. Daio, A. Kai, T. Shimonosono, R. Yano, S. Sameshima and K. Yamaji, "Performance of yttria-stabilized zirconia fuel cell using H_2–CO_2 gas system and CO–O_2 gas system", Ceramics International, Vol. 42, pp. 18373-18379, 2016.

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