

Supporting Information

Doped CeO₂-LaFeO₃ Composite Oxide as an Active Anode for Direct Hydrocarbon-Type Solid Oxide Fuel Cells

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BRIEFS: Cell using a Ce(Mn,Fe)O₂-La(Sr)Fe(Mn)O₃ composite anode showed improved power generating properties in hydrocarbon compared to that in the case of hydrogen with enhanced electrical conductivity of oxide anode at reducing atmosphere

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1. Equilibrium oxygen partial pressure during operation

Table S1. Equilibrium oxygen partial pressure at 1073K in various hydrocarbon fuels.

Current density (A/cm ²)	log (P_{O_2}/atm) ^{a)}			
	CH ₄	C ₂ H ₆	C ₃ H ₈	C ₄ H ₁₀
0	-24.03	-24.4	-24.7	-24.9
0.1	-23.9	-24.3	-24.6	-24.8
0.2	-23.8	-24.2	-24.4	-24.6
0.3	-23.7	-24.1	-24.3	-24.5
0.4	-23.6	-24	-24.2	-24.4

^{a)} 0.2 cm² of electrode area and 100ml min of fuel feeding rate was considered.

Oxygen partial pressure as a function of current density was estimated by using the thermodynamic database, "MALT"(Kagaku Gijyutsu-sha, Japan). For this calculation, we input the initial composition of hydrocarbon and oxygen which is estimated with Faraday law and current density, and the equilibrium oxygen partial pressure was calculated against the input gas composition. In addition, when calculating P_{O_2} for various hydrocarbons, approximately 0.2 cm² of electrode area and 100ml min⁻¹ of fuel feeding rate was considered. At high temperature such like 1073K, complicate gas reaction in anode site from hydrocarbon; it might easily conform to the equilibrium state than that in low temperature. As shown in Table S1, the oxygen partial pressure decreased with increasing carbon number in alkane. P_{O_2} in propane or butane fuel is low values which lead to the reduced IR loss for the composite oxide anode from P_{O_2} dependence of the electrical conductivity (Fig. 12). Therefore, one reason for improved power density could be assigned to the increased conductivity of the oxide anode when C₃H₈ or C₄H₁₀ was used for fuel.