Intermediate Temperature Fuel Cell with Proton Conducting Thin Film Electrolyte

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Much attention has been devoted to the development of intermediate temperatures fuel cells (ITFCs), of which operating temperature range is 100~400°C. In^{3+} doped Tin pyrophosphate ($Sn_{0.9}In_{0.1}P_2O_7$), that has been reported as a promising candidate electrolyte for the ITFCs, exhibited high proton conductivities above 10^{-2} Scm^{-1} around 200°C under unhumidified conditions. However, for a fuel cell using this material as an electrolyte, $Sn_{0.9}In_{0.1}P_2O_7$ powders were merely pressed into pellets, due to the poor sinterability of this material. Area specific resistance (ASR) of 0.34 Ωcm^2 was achieved with 0.31 mm-thick electrolyte, but open circuit voltages (OCVs) were decreased with reducing the electrolyte thickness (0.83 V), due to gas crossover through the electrolyte. Therefore, the synthesis of a dense and thin electrolyte membrane is a crucial requirement for the practical applications of this material.

Here, we present the first successful fabrication of fully dense amorphous $Sn_{0.9}In_{0.1}P_2O_7$ thin film proton conductor membrane which exhibits extremely low ASR of 0.04 Ωcm2 without any additional humidification at 200°C and OCVs higher than 0.9 V in the fuel cells based on the thin film electrolyte.