Intermediate-temperature, non-humidified fuel cells with highly proton-conducting inorganic electrolyte

허필원*, 김기현, 박찬호, 최경환, Takashi Hibino[1]
삼성종합기술원; [1]Nagoya University
(pilwon.heo@samsung.com*)

Proton conductors capable of operation at intermediate temperature of 100–300 °C and under non-humidified conditions are required for fuel cell system with lower cost and higher efficiency. Various types of anhydrous proton conductors have been investigated thus far. Recently, several metal pyrophosphates have been reported to exhibit relatively high proton conductivity at the intermediate temperatures. In this study, a series of $A^{III}_{0.5}B^{V}_{0.5}P_2O_7$ compounds were investigated as promising proton conductors (A^{III} and B^{V} denote trivalent and pentavalent metals, respectively). A series of $A^{III}_{0.5}B^{V}_{0.5}P_2O_7$ compounds were synthesized, of which $In_{0.5}Sb_{0.5}P_2O_7$, $Fe_{0.5}Nb_{0.5}P_2O_7$, and $Fe_{0.5}Ta_{0.5}P_2O_7$ exhibited the highest proton conductivities in the intermediate temperature, in non-humidified air. The proton conductivity of these compounds was further enhanced by the introduction of A^{III} or B^{V} deficiency into the bulk. Consequently, $Fe_{0.4}Ta_{0.5}P_2O_7$ exhibited the highest proton conductivities of 0.06 S cm^{-1} at 100 °C and 0.27 S cm^{-1} at 300 °C. We also demonstrated a non-humidified hydrogen-air fuel cell using $Fe_{0.4}Ta_{0.5}P_2O_7$ as an electrolyte in the temperature range.