Facile Synthesis and Enhanced Intermediate Temperature Electrical Properties of Novel Sn$_{0.9}$Mg$_{0.1}$P$_2$O$_7$/KSn$_2$(PO$_4$)$_3$ Composite Electrolyte

Junlong Liu, Ruifeng Du, Ruijuan Shi*, Hongtao Wang*

School of Chemical and Material Engineering, Fuyang Normal College; Anhui Provincial Key Laboratory for Degradation and Monitoring of Pollution of the Environment, Fuyang 236037, China

E-mail: hongtaoking3@163.com, rjshi@foxmail.com

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The application of Sn$_{1-x}$M$_x$P$_2$O$_7$ electrolyte for solid oxide fuel cells is limited due to its poor sintering abilities. In this study, a new Sn$_{0.9}$Mg$_{0.1}$P$_2$O$_7$/KSn$_2$(PO$_4$)$_3$ composite electrolyte was facile synthesized and the structural and microstructural properties were characterized by XRD and SEM. These results exhibit that the Sn$_{0.9}$Mg$_{0.1}$P$_2$O$_7$/KSn$_2$(PO$_4$)$_3$ composite can be obtained by Sn$_{0.9}$Mg$_{0.1}$P$_2$O$_7$ in-situ reacted with inorganic melt salt. The electrical properties were tested using impedance spectroscopy in the range of 300 ~ 700 °C. The highest conductivity of Sn$_{0.9}$Mg$_{0.1}$P$_2$O$_7$/KSn$_2$(PO$_4$)$_3$ achieved was 6.3×10$^{-2}$ S·cm$^{-1}$ in a dry nitrogen atmosphere at 700 °C. A H$_2$/O$_2$ fuel cell with a dense Sn$_{0.9}$Mg$_{0.1}$P$_2$O$_7$/KSn$_2$(PO$_4$)$_3$ electrolyte membrane was also constructed and achieved maximum power output densities of 47.2 mW·cm$^{-2}$ and 130.9 mW·cm$^{-2}$ at 600 °C and 700 °C, respectively.

Keywords: Composite electrolyte; Intermediate temperature fuel cell; Ceramics; Conductivity

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