A Ternary Composite $\text{Ti}_{0.95}\text{Fe}_{0.05}\text{P}_2\text{O}_7/\text{NaPO}_3/\text{NaTi}_2(\text{PO}_4)_3$ Electrolyte with Enhanced Electrochemical Performance for Solid Oxide Fuel Cells

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A novel ternary composite $\text{Ti}_{0.95}\text{Fe}_{0.05}\text{P}_2\text{O}_7/\text{NaPO}_3/\text{NaTi}_2(\text{PO}_4)_3$ electrolyte was successfully fabricated by a simple solid-phase method at 700 °C. The phase composition, morphology and electrochemical properties of the ternary composite electrolyte were characterized by means of X-ray powder diffraction (XRD), scanning electron microscopy (SEM) and electrochemical impedance spectroscopy (EIS). The results indicated that the electrochemical performance of the ternary composite electrolyte was better than that of single-phase Mg- or Fe-doped TiP_2O_7 and a conductivity of $3.9 \times 10^{-2} \text{ S} \cdot \text{cm}^{-1}$ was obtained at 800 °C in a dry nitrogen atmosphere. H_2/O_2 fuel cell performance using the ternary composite $\text{Ti}_{0.95}\text{Fe}_{0.05}\text{P}_2\text{O}_7/\text{NaPO}_3/\text{NaTi}_2(\text{PO}_4)_3$ as the electrolyte was examined. An open circuit voltage of approximately 1.04 V and a maximum power output density of $167.1 \text{ mW} \cdot \text{cm}^{-2}$ were achieved at 800 °C. This work offers a new alternative for the design of ternary composite metal pyrophosphates electrolyte.

Keywords: Composite electrolyte; Conductivity; Fuel cell; XRD

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