A Novel Perovskite structure anode of SOFC for Production of Electricity and Separation of CO from Syngas

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Introduction
Syngas (H₂+CO) has wide applications. It is an important raw material for organic synthesis and can be used as fuel. Recently, the solid oxide fuel cell (SOFC) has attracted much attention because of its fuel flexibility, high efficiency of using fuel and environmental friendly characteristics 1). Previous studies 2) showed that the electronic and ionic conductivity of a Fe-based perovskite structure composite could be enhanced by substituting A-site of La by Sr. And the B site of Fe could be partially substituted by Cr to sustain high disorder of oxygen vacancy.

We proposed to use proton conducting solid oxide fuel cell (PCSOFC) for generating electricity and enriching CO from syngas. In the PCSOFC, oxygen in the cathode cannot transport to anode to oxidize CO. Therefore, in the anode chamber, H₂ is oxidized and the protons transport to cathode through the proton conducting electrolyte to react with oxygen to form water in cathode chamber. In this work, we fabricated La₀.₃Sr₀.₇Fe₀.₇Cr₀.₃O₃ₓ (LSFC), a perovskite structure composite, as the anode catalyst for SOFCs. The chemical stabilities in different gas atmospheres at operating temperature were investigated.

Experimental
The LSFC composite powders were prepared by a modified-combustion method 4). Stoichiometric amounts of metal nitrates were first dissolved in water. Subsequently, glycine was added with the molar ratio of glycine: total metal as 2:1. The solution was then stirred and heated on a hot plate until ignited to form fine nano-powder. The powders were calcined at 1200 °C for 2 h in air by the rate of 2 °C/min.

To study high temperature phase and chemical stabilities, the XRD patterns for LSFC before and after the treatment in (a) 10%H₂+N₂ at 700 °C for 8 h, (b) in humidified CO₂ (3% H₂O) at 700 °C for 8 h. The results indicate that the LSFC had excellent chemical stability in CO₂ and H₂O at the operating temperature and therefore could be a promising electrode material for SOFC fueled by syngas.

Figure 1. XRD patterns of LSFC before and after the treatment in different atmospheres at 700 °C for 8 h.

Conclusion
The LSFC exhibits high chemical stability in H₂ and good tolerance to CO₂ and H₂O, which is an important characteristic for promising electrode material for syngas SOFC.

References