Ruddlesden-Popper structured catalysts with in situ exsolved Fe nanoparticles for CO_2 electrolysis in SOECs

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Solid oxide electrolysis cell (SOEC) is an efficient system for CO_2 electrolysis. However, its cathode material has suffered from performance degradation and low catalytic activity. In this study, we prepare a $(La,Sr)_2(Mn,Fe)O_4$ with in situ exsolved Fe nanoparticles (Fe-R.P.LSMF) by directly reducing a perovskite-derivate of LSMF for use as SOEC cathode. During the reduction process, perovskite-derivate is transformed into Ruddlesden-popper phase with the formation of strongly socketed Fe nanoparticles on the surface of the catalyst. The single cell with Fe-R.P.LSMF cathode shows an outstanding current density value at a voltage of 1.3 V and temperature of 850 ℃ with a very high Faraday efficiency. Furthermore, the cell shows a stable performance in current density over the 100 h continuous operation, indicating the Fe-R.P.LSMF is quite robust cathode material for the CO_2 electrolysis. In situ exsolved Fe nanoparticles formed on the surface of catalyst are responsible for its electrochemical performance and high stability. Therefore, the Fe-R.P.LSMF developed in this study could give an opportunity to be applied as a promising cathode material for the CO_2 electrolysis reaction.