Exsolved Fe nanoparticles on Ruddlesden-Popper oxide for CO_2 electrolysis cathode in solid oxide electrolysis cell

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Although Solid oxide electrolysis cell (SOEC) is an efficient system for CO_2 electrolysis, conventional cathode material, Ni/YSZ, has suffered from degradation problem caused by particle agglomeration, carbon deposition, etc. In this study, *in situ* exsolution with phase transition was used to prepare active metal nanoparticles socketed on the oxide surface and Ruddlesden-Popper support at relatively low annealing temperature. The cathode catalyst, Fe-R.P.LSMF, was prepared by in situ annealing of LSMF in flowing H_2 at operation condition. The SOEC button cell with the configuration of LSMF-GDC|LSGM|LSCF-GDC was used for CO_2 electrolysis with pre-reduction in H_2 for cathode side before the CO_2 electrolysis test. The cell shows high current density value at 1.5 V and 850 ℃ with a almost 100% Faraday efficiency. In addition, the cathode material showed stable long-term performance over the 100 h continuous operation. Therefore, the Fe-R.P.LSMF highly promising candidate with high performance and stability for CO_2 electrolysis cathode in SOEC.