Sulfur tolerant catalyst fabricated with in situ exsolved CoNi alloy nanoparticles socketed on Ruddlesden-Popper support for efficient CO_2 electrolysis to CO

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We have developed a new and efficient sulfur-tolerant catalyst for use in SOEC cathode fabricated with in situ exsolved and socketed CoNi nanoparticles on the Ruddlesden-Popper (R.P.) support of $La_{1.2}Sr_{0.8}Co_{0.4}Mn_{0.6}O_4$, and its catalytic activity for CO_2 electrolysis to CO was evaluated under a CO_2 gas stream that contains H_2S species. This catalyst was prepared by in situ annealing of perovskite-derivatives in a 20% H_2/N_2 gas at 800 °C, which exhibited a good reversibility of structural transition during redox cycles. A high current density of 703 mA/cm^2 was achieved at 1.3 V and 850 °C with a Faraday efficiency of 97.8%. In situ grown CoNi nanoparticles and high oxygen vacancy contents in the R.P. support should be responsible for its high catalytic activity and efficiency. Importantly, no sign of degradation is indicated as observed by galvanostatic tests over a period of 90 h operation in an H_2S-contained CO_2 gas condition. This Ruddlesden-Popper material with in situ exsolved CoNi nanoparticles should a promising cathode for practical application to H_2S-contained CO_2 gas conditions.