Solid oxide fuel cell for methane internal reforming

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Solid oxide fuel cells (SOFCs) are considered as the most promising future component for energy generation in power plants and distributed power systems, which can directly convert various fuels, such as hydrogen, natural gas and ethanol, to electrical energy through electrochemical processes with high efficiency. SOFCs, when compared to other fuel cell systems, offer the greater flexibility in terms of fuel by internal reforming of natural gas, ethanol or hydrocarbon fuels, which may occur directly on the anode. One of the challenges of using fuel cells as a commercial alternative for electricity generation is the fact that they usually require high purity hydrogen as fuel. High purity hydrogen production and distribution add additional levels of complexity to the overall system. However, oxidation of hydrocarbons fuels directly on SOFC anodes has been experimentally demonstrated by a number of authors . Methane is the simplest and widely available hydrocarbon with a huge resource in the world. It is the main component of natural gas and coal gas. It is also the main component of biogas and can be treated as a renewable energy resource. Nowadays, there is a great interest of SOFC operating on methane fuel. Typically there are three routes available for operating on methane fuel in a SOFC, i.e., direct electrochemical conversion, external reforming and internal reforming. The later route is superior to external reforming because of their simplicity. In this paper, a nickel-iron alloy catalyst layer was proposed as a dual-functional layer over traditional Ni–YSZ anode and support for operating on methane fuel. The effects of processing temperature and porosity are discussed. The performances and stabilities of SOFCs were characterized.