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Gradual Internal Reforming process: development of catalyst layer for Solid Oxide Fuel Cells operating with methane and bioethanol

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In the gradual internal reforming (GIR) process, the water released by the electrochemical oxidation of hydrogen at the anode is used for the steam reforming of the fuel in the catalytic layer deposited over the anode of the SOFC. We have developed a highly active ceria-based catalytic layer that efficiently converts the primary fuel (ethanol or methane) into hydrogen using the electrochemically-generated steam. Ir/CGO catalyst was pretreated at 1173 K in He flow with less than 0.5 ppm O2 prior to catalytic testing. The catalyst consists of Ir nanoparticles (mean size of 4 nm in diameter) supported on the surface of sub-micron gadolinia-doped ceria particles and forms a continuous porous layer (~25 ?m thick) over the Ni-based anode. An anode-supported solid oxide fuel cell (SOFC) was continuously operated for more than 300 hours with direct methane or (anhydrous) ethanol, with a high current density. The catalytic layer associated with the GIR process avoids the carbon deposition on the anode material surface. Such results represent a significant advance towards the development of fuel-flexible SOFC operating with methane or ethanol.