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**Review of fuel processing catalysts for hydrogen production in PEM fuel cell systems**

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The rapid development in recent years of the proton-exchange membrane (PEM) fuel cell technology has stimulated research in all areas of fuel processor catalysts for hydrogen generation. The principal aim is to develop more active catalytic systems that allow for the reduction in size and increase the efficiency of fuel processors. The overall selectivity in generating a low CO content hydrogen stream as needed by the PEM fuel cell catalyst is dependent on the efficiency of the catalysts in each segment of the fuel processor. This article reviews the advances achieved during the past few years in the development of catalytic materials for hydrogen generation through fuel reforming,1 water-gas shift and carbon monoxide preferential oxidation, as used or aimed to be of use in fuel processing for PEM fuel cell systems.

# Hydrogen production for fuel cells through methane reforming at low temperatures

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Hydrogen production for fuel cells through methane (CH4) reforming at low temperatures has been investigated both thermodynamically and experimentally. From the thermodynamic equilibrium analysis, it is concluded that steam reforming of CH4 (SRM) at low pressure and a high steam-to-CH4 ratio can be achieved without significant loss of hydrogen yield at a low temperature such as 550 °C. A scheme for the production of hydrogen for fuel cells at low temperatures by burning the unconverted CH4 to supply the heat for SRM is proposed and the calculated value of the heat-balanced temperature is 548 °C. SRM with and/or without the presence of oxygen at low temperatures is experimentally investigated over a Ni/Ce–ZrO2/θ-Al2O3 catalyst. The catalyst shows high activity and stability towards SRM at temperatures from 400 to 650 °C. The effects of O2:CH4 and H2O:CH4 ratios on the conversion of CH4, the hydrogen yield, the selectivity for carbon monoxide, and the H2:CO ratio are investigated at 650 °C with a constant CH4 space velocity. Results indicate that CH4 conversion increases significantly with increasing O2:CH4 or H2O:CH4 ratio, and the hydrogen content in dry tail gas increases with the H2O:CH4 ratio.