

Core-shell catalysts for ethanol steam reforming reaction

Reference	Presenter	Authors (Institution)	Abstract
01-028	João Coutinho Ferreira	Moraes, T.S. (Instituto de Pesquisas Energéticas e Nucleares); Ferreira, J.C. (Instituto de Pesquisas Energéticas e Nucleares); Bergamaschi, V.S.(Instituto de Pesquisas Energéticas e Nucleares); Spinacé, E.V. (Instituto de Pesquisas Energéticas e Nucleares);	<p>Hydrogen can be produced from the steam reforming (SR) of biomass-derived liquids such as bioethanol. The SR of ethanol for hydrogen production has several advantages. However, one of the main barriers to the commercialization of this technology is the deactivation of the catalysts due to the formation of carbon. Therefore, the development of catalysts that are stable and resistant to carbon formation is necessary. Several strategies have been used to avoid the deposition of carbon on the surface of the catalysts. Cerium oxide, at high temperatures or in the presence of reducers, can easily change oxidation state to form a non-stoichiometric oxygen deficient oxide. This oxide has a strong tendency to remain in the fluorite structure even after considerable oxygen loss, stabilizing the structure with a high number of oxygen vacancies. Other approach to minimize coke formation is to control the size of metallic particle through modifications in the catalyst structure. According to the mechanism reported in the literature, carbon formation in these reactions are favored in large sizes of metal particle. Therefore, controlling particle size is essential to reduce carbon accumulation on the catalyst surface during ethanol reforming reactions. One strategy for inhibiting the sintering process of metal particles in catalysts is the development of core-shell catalysts. These catalysts feature a metal core covered with an oxide layer, which gives them unique characteristics. The core-shell structure also accelerates the transformation processes of the carbon formed at the metal-oxide interface, favoring the gasification reaction and consequently its elimination in the form of CO₂. Das et al have synthesized an innovative sandwiched core-shell structured Ni-SiO₂@CeO₂ catalyst that showed high activity and stability at dry reforming of biogas with negligible coke formation. The aim of this work is to investigate the performance of the structurally modified Ni-SiO₂@CeO₂ catalyst in the form of a sandwiched core-shell to inhibit the formation of carbon and increase the stability of the catalysts in the SR of ethanol reaction. This new form of catalyst synthesis has proved very efficient in other reactions but is still very little studied in the ethanol SR reaction. Silica nano-spheres were synthesized by the Stöber method and Ni-SiO₂ catalysts were prepared via a Ni-phyllosilicate precursor route. Ni-SiO₂@CeO₂</p>

will be prepared using the fresh Ni-phyllsilicate spheres that will be coated with a thin layer of CeO₂ using a precipitation method. Silica nano-spheres and Ni-SiO₂ were calcined at 1273 K for 1 hour with air. Samples were analyzed using transmission electron microscope (TEM) and x-ray diffraction (XRD). SR of ethanol was performed in a fixed-bed reactor at atmospheric pressure. Prior to reaction, catalysts were reduced under pure hydrogen at 923 K for 1 h. The reactions were carried out at 673K and H₂O/ethanol molar ratio of 3.0.

<< Back