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Synthesis and Characterization of Catalysts Based on Nickel, Cerium, and Lanthanum Supported on Biocarbon for Ethanol Steam Reforming

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Ethanol steam reforming (ESR) is considered asa promising alternative for hydrogen production due to some differentadvantages that include the large availability, relatively low cost, andsuperior reactivity of ethanol as compared to other compounds. Thus, thistechnology is also considered more sustainable and greener as compared to othermethods usually employed for hydrogen production. However, the currentindustrial catalysts suffer from strong deactivation because the extensivecarbon deposition, which limits their performances and utilization. In order toovercome this limitation, we report herein the synthesis of a catalyst based onnickel, cerium and lanthanum supported on activated biocarbon by a microwaveassisted hydrothermal method. In this method, we first performed a hydrothermalactivation of the biocarbon support at 120 °C using nitric acid (0.3 M) in areactor coupled to a microwave source aiming the formation of acid groups atthe surface of our carbonaceous matrix. In a next step, the adsorption of La3+,Ce3+, and Ni3+ onto the activated biocarbon was performed by the addition ofLa(NO3)3.6H2O, Ce(NO3)3.6H2O, and Ni(NO3)3.6H2O in the suspension containingthe activated biocarbon and potassium thiosulfate for stabilization (pH 8.0) at75 °C. The obtained catalyst was then characterized by scanning electronmicroscopy, X-ray dispersive spectroscopy, X-ray diffraction, temperatureprogramed reduction, and surface area by the BET method. After this step, the catalystwas then evaluated towards the ESR, in which 100 % of ethanol conversion wasobserved with the formation of only H2 (~ 60%) and CO2 (ESR products) and COand CH4 as byproducts (both in low concentrations), indicating a goodselectivity for ESR. Good stability was also achieved with no significant lossof activity even after 24 hours of reaction at 550 °C. The reactants and thereaction products were analyzed by gas chromatograph (Agilent 7890A), equippedwith a thermal conductivity detector (TCD) and a flame ionization detector(FID) connected in series.