Effect of Ni loading on SBA-15 synthesized from palm oil fuel ash waste for hydrogen production via CH_4 dry reforming

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ABSTRACT

The successful synthesis of SBA-15 using silica source extracted from palm oil fuel ash (POFA) was proven with the presence of mesostructure characteristics as evidenced by low angle XRD, N_2 adsorption-desorption isotherms and TEM. Different amounts of Ni were loaded on the synthesized SBA-15(POFA) using the impregnation method at 80 °C. The influence of Ni loading over the Ni/SBA-15(POFA) physiochemical properties and CO_2 reforming of CH_4 (CRM) were investigated in a stainless steel fixed-bed reactor at 800 °C and atmospheric pressure with 1:1 CO_2:CH_4 volumetric feed composition. An increment in Ni loading on SBA-15(POFA) from 1 to 5 wt% decreased the BET surface area and crystallinity of catalyst as proven by N_2 adsorption–desorption and XRD analysis. The catalytic performance of CRM followed the sequence of 3 wt% > 5 wt% > 2 wt% > 1 wt% -Ni/SBA-15(POFA). This result was owing to the even distribution of Ni and good Ni–O–Si interaction of 3 wt% Ni/SBA-15(POFA) as proved by TEM, FTIR and XPS. Lowest H_2/CO ratio and catalyst activity and stability of 1 wt% Ni/SBA-15(POFA) were due to the weaker Ni–O–Si interaction and small amount of basic sites that favor the reverse water gas shift (RWGS) reaction and carbon formation. The recent finding indicates that a quantity as small as 3 wt% Ni loaded onto SBA-15(POFA) could elicit outstanding catalytic performance in CRM, which was comparable with 10 wt% Ni loading catalysts reported in literature.

KEYWORDS

POFA; CO_2 reforming; Ni/SBA-15; Silica source; Ni support interaction

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