

Influence of impregnation assisted methods of Ni/SBA-15 for production of hydrogen via dry reforming of methane

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ABSTRACT

SBA-15 support was successfully synthesized using extracted silica from palm oil fuel ash waste (POFA). Four types of Ni/SBA-15 catalysts were prepared via the ordinary impregnation technique (Ni/SBA-15(IM)) and assisted impregnation techniques including rotary evaporator (Ni/SBA-15(RE)), shaker (Ni/SBA-15(SH)) and ultrasonic (Ni/SBA-15(US)). The attributes of the Ni/SBA-15 were characterized using XRD, BET, FTIR, XPS, TEM, CO₂-TPD and TGA. The performance and stability of Ni/SBA-15 catalysts for up to 24 h were determined using a stainless steel fixed-bed reactor setup at 800 °C. The results in a descending order were ultrasonic (US) > ordinary impregnation (IM) > shaker (SH) > rotary evaporator (RE). The highest catalytic performance was achieved by Ni/SBA-15(US) owing to the location of Ni species inside the SBA-15 micelles, stronger Ni–O–Si interaction, and higher catalyst basicity. Lowest formation of graphite carbon on Ni/SBA-15(US) was correlated to the good dispersion of smaller Ni particles that were able to suppress the coke formation. The ultrasonic irradiation provided a cavitation effect which was able to destroy the soft agglomeration of Ni particles for better dispersion compared to IM, RE, and SH. This study provides an alternative in preparing better properties of catalyst to enhance the CO₂ reforming of CH₄ (CRM) in terms of activity and stability.

KEYWORDS

POFA; DRM; Catalyst preparation method; Ultrasonic; H₂/CO

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