Hydrogen production via CO2 reforming of CH4 over low-cost Ni/SBA-15 from silica-rich palm oil fuel ash (POFA) waste

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ABSTRACT

H2 was produced via CO2 reforming of CH4 (CRM) using low-cost Ni/SBA-15 synthesized from palm oil fuel ash (POFA) waste as silica precursor. A series of Ni/SBA-15 were synthesized by employing different Na2SiO3-POFA/P123 mass ratios (2.0, 2.9 and 4.0) and were compared with Ni/SBA-15 prepared from commercial Na2SiO3 (Ni/SBA-15(Comm.)). Na2SiO3-POFA/P123 ¼ 2.9 was found to be the optimal synthesis ratio, which produces a well-defined hexagonal framework, smaller NiO particles, stronger Ni-support interaction, homogeneous metal distribution and higher amount of basic sites. The catalytic performance complied with the trend of Ni/SBA-15(R4.0) < Ni/SBA-15(R2.0) < Ni/SBA-15(R2.9) z Ni/SBA-15(Comm.), indicating the excellent catalytic activity of Ni/SBA-15(R2.9) (H2 selectivity ¼ 87.6%). The favorable physicochemical properties of Ni/SBA-15(R2.9) ameliorated the active Ni metals stabilization over SBA-15 and boosted the catalyst's virtues towards an outstanding catalytic performance. Hence, it is affirmed that POFA with an optimal Na2SiO3-POFA/P123 ratio of 2.9 can be served as silica substitution of Ni/SBA-15 for efficient H2 production via CRM.

KEYWORDS: Dry reforming; Hydrogen; POFA; Silica/surfactant; Ni/SBA-15