Thermally stable monodispersed Ni-Co nanoparticles encapsulated with SiO_2 shell for dry reforming of methane

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Enhanced thermal and catalytic stability of monodispersed Ni-Co nanoparticles with homogeneous size distribution of ~6 nm encapsulated with SiO_2 shells (NC@Si) were verified for a dry reforming of methane with CO_2 (DRM). The extents of coke formation and aggregation of Ni-Co nanoparticles were effectively suppressed with positive contributions of oxophilic Co species as well as by their spatial confinement effects. The optimal N_8C_2@Si with Ni/Co molar ratio of 4 revealed relatively higher CH_4 and CO_2 conversions of 74.1 and 83.7% at T = 800 °C without significant deactivation. A superior catalytic activity and stability of the N_8C_2@Si were attributed to the highly-dispersed oxophilic metallic cobalt oxides in monodispersed Ni-Co nanoparticles, which enhanced CO_2 adsorption capacity and increased thermal stability of spatially confined Ni-Co nanoparticles with the help of mesoporous SiO_2 shells at its optimal aging time less than 4 h.