Development of Coke- and sintering-resistant Ni/SiO₂-based dry reforming catalyst by depositing a thin layer of AI_2O_3 via ALD

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The dry reforming of methane, DRM (CH₄ + CO₂ \rightarrow 2CO + 2H₂), is a promising process to convert two greenhouse gases into a synthesis gas (H₂/CO), that is a key intermediate for liquid fuels synthesized via the Fischer-Tropsch process [1]. Due to its comparatively low price (when compared to noble metals) and high activity, Ni-based catalysts are attractive for DRM. The main deactivation mechanisms of Ni-based dry methane reforming (DRM) catalysts are sintering and coke deposition, the extent of coke deposition being critically affected by the size of the Ni particles [2, 3]. Thus, by controlling and stabilizing the Ni particle size Ni-based DRM catalysts that possess a high and stable activity can be realized. In this work, we have developed Al₂O₃-coated, SiO₂-supported Ni DRM catalysts using atomic layer deposition (ALD). Catalysts with different Al₂O₃-shell thicknesses were prepared. Coating of Ni nanoparticles with an Al₂O₃ shell increases appreciably the catalysts' resistance to sintering and coke formation when compared to unmodified SiO₂-supported Ni.

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