Development of Coke- and sintering-resistant Ni/SiO_2-based dry reforming catalyst by depositing a thin layer of Al_2O_3 via ALD

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The dry reforming of methane, DRM ($CH_4 + CO_2 \rightarrow 2CO + 2H_2$), is a promising process to convert two greenhouse gases into a synthesis gas (H_2/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 Al_2O_3-coated, SiO_2-supported Ni DRM catalysts using atomic layer deposition (ALD). Catalysts with different Al_2O_3-shell thicknesses were prepared. Coating of Ni nanoparticles with an Al_2O_3 shell increases appreciably the catalysts' resistance to sintering and coke formation when compared to unmodified SiO_2-supported Ni.

[1] K. Fujimoto, K. Omata, T. Nozaki, O. Yamazaki and Y. Han, *Energy Conversion and Management* **1992**, *33*, 529-536.
[2] V. Kroll, H. Swaan and C. Mirodatos, *Journal of Catalysis* **1996**, *161*, 409-422.
[3] J. Richardson and S. Paripatyadar, *Applied Catalysis* **1990**, *61*, 293-309.