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Photo-Enhanced Catalytic Dry Reforming of Methane on Ni@SiO2 with High Resistance to Carbon

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Abstract : Methane and carbon dioxide are major greenhouse gases contributor. CO_2 dry reforming of methane (DRM) for syngas production is a promising approach to reducing global CO_2 emission and extensive utilization of natural gas. However, the reported catalysts endured rapid deactivation due to severe carbon deposition at high temperature. Here, CO_2 reduction by CH4 on hexagonal nano-nickel flakes packed by porous SiO_2 ($Ni@SiO_2$) catalysts driven by thermal and solar light are tested. High resistance to carbon deposition and higher reactive activity are demonstrated under focused solar light at moderate temperature (400-500 ℃). Furthermore, the photocatalytic DRM under different wavelength is investigated, and even IR irradiation can enhance the catalytic activity. The mechanism of light-enhanced reaction reactivity and equilibrium is investigated by Infrared and Raman spectroscopy, and the unique reaction pathway with light is depicted. The photo-enhanced DRM provides a promising method of renewable solar energy conversion and CO_2 emission reduction due to the excellent activity and durability.

Keywords : CO_2 emission reduction, methane, photocatalytic DRM, resistance to carbon deposition, syngas
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