

Mechanistic investigation of methane steam reforming over Ce-promoted Ni/SBA-15 catalyst

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Abstract Methane steam reforming experiments were carried out at atmospheric pressure for temperatures between 873 and 1073 K and by varying the partial pressure of methane and steam to achieve S:C between 0.5 and 2.5. Mechanistic considerations for Methane steam reforming (MSR) were derived on the basis of Langmuir–Hinshelwood and Eley–Rideal reaction mechanisms based on single- and dual-site associative and dissociative adsorption of one or both reactants. However, discrimination of these models on statistical and thermodynamic grounds revealed that the model representing a single-site dissociative adsorption of methane and steam most adequately explained the data. However, the product formation rates from these experiments were reasonably captured by power-law model. The parameter estimates from the power-law model revealed an order of 0.94 with respect to methane and -0.16 for steam with activation energy of 49.8 kJ mol⁻¹ for MSR. The negative order with respect to steam for methane consumption was likely due to steam inhibition.

Keywords Steam reforming, Methane, SBA-15, Nickel catalyst, Ceria-promotion, Kinetic models

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