ACS 2014 Spring Meeting, Chemistry and Materials for Energy, Dallas, Texas.
Division of Catalysis Science and Technology.
Oral Presentation - Catalytic Processes for CO_2 Utilisation: Development of Thermal, Photo and Electrocatalysis Based on Mechanistic Insights.

The application of inelastic neutron scattering to investigate the 'dry' reforming of methane over an alumina-supported nickel catalyst operating under conditions where filamentous carbon formation is prevalent

David Lennon, Andrew R. McFarlane, Ian P. Silverwood, Robbie Warringham, Elizabeth L. Norris, R. Mark Ormerod, Christopher D. Frost and Stewart F. Parker.

Abstract
The use of CO_2 in reforming methane to produce the industrial feedstock syngas is an economically and environmentally attractive reaction. An alumina-supported nickel catalyst active for this reaction additionally forms filamentous carbon. The catalyst is investigated by inelastic neutron scattering (INS) as well as elemental analysis, temperature-programmed oxidation, temperature-programmed hydrogenation, X-ray diffraction, transmission electron microscopy and Raman scattering. Isotopic substitution experiments, using $^{13}CO_2$ for $^{12}CO_2$, show the oxidant to contribute to the carbon retention evident with this sample. At steady-state operation, a carbon mass balance of 95 % is observed. The INS measurements provide guidance as how hydrogen is partitioned within the catalyst matrix. A kinetic scheme is proposed to account for the trends observed.

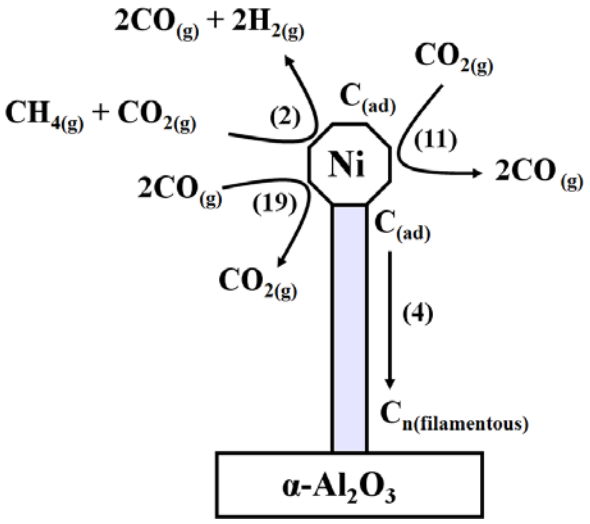

Figure 1. A schematic diagram illustrating some of the main reactions active during the dry reforming of methane and the formation of filamentous carbon as a by-product. The numbers in parenthesis correspond to elementary reactions considered in the presentation. The partitioning of hydrogen within the catalyst matrix role is informed by INS spectra.