Poster Presentation

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Impact of reduction temperature on Pt Morphology in Pt/gamma-Alumina

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Supported Pt clusters are important catalysts for many reactions such as hydrogenation and dehydrogenation of hydrocarbons. Understanding the formation, size and shape of 1nm Pt clusters will assist in developing improved catalysts for many different catalytic processes.

The unique insights are obtained based on the combination of EXAFS (Extended X-ray Absorption Fine Structure) and aberration-corrected electron microscopy into formation and structure of nanometer sized metal clusters. The reduction and decomposition of the initial chlorinated Pt precursor was monitored during in situ reduction at both the Pt L3-edge and Cl K-edge. Cl XANES spectra indicate that Pt-Cl binding weakens in the temperature range from 125 to 250°C. EXAFS spectra from the Pt metal clusters are used to determine the average size and shape. EXAFS data were collected after the sample had been reduced at 300, 400, 500 and 700°C in 100% H2 (10°C.min heating rate). The average Pt cluster size does not vary significantly as a function of reduction temperature. Indeed, there is a suggestion that the Pt clusters become more ordered and decrease in size (decrease in Pt-Pt1 CN) at higher reduction temperatures. With steaming larger clusters can be formed. Growth of these clusters appears to be initially in 2 dimensions but with increasing size they start approaching a more 3 dimensional structure. EXAFS results based on coordination number for a reduced sample showed a 2-dimensional structure as well. Thus EXAFS provides precise average structural information of the entire sample and this global average information are compared with the spatially-resolved data of HAADF-STEM imaging.

The combination of EXAFS and probe-corrected HAADF-STEM imaging are very insightful and provides a more complete understanding of the supported Pt clusters. Clusters tend to be 2 dimensional at the 1nm size range with some of the Pt as isolated atoms on the catalyst support. The number of Pt atoms in these clusters range from 15 to 25.

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