Dumbbell-like nanocrystals: ideal model catalysts to study structure-activity correlations

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Abstract:

Heterogeneous catalysis is among the earliest known applications of nanomaterials, although this has been clearly recognized only a few decades ago. Indeed, in the rational design and application of these materials, one deals with the manipulation of materials' properties at the nanoscale. However, the conventional methods for catalyst preparation typically result in a material with a considerable level of inhomogeneity in terms of these nanoscale properties. The application of colloidal synthesis methods in the catalyst preparation, on the other hand, provides a unique tool for the detailed study of the properties of the active sites. These methods offer the possibility of: (a) size and shape tuning to study the effect of size and find about the most active facet of the NCs, (b) composition tuning for evaluation of the synergies between different constituents especially in case of bimetallic or composite catalysts, and (c) design of architecture for careful examination of metal-support interaction.

In this presentation, I will talk about a number of case-studies on the colloidal dumbbell-like nanocrystals (DNCs) representative of a well-known metal / oxide catalyst for CO oxidation, namely the gold-iron oxide. These nanocomposites were applied as model systems for a fundamental understanding of the contributions from different aspects of the composite catalytic systems such as metal size, compositions and metal-support interaction in the CO oxidation activity. Understanding all these aspects can indeed reveal the structure-activity correlations and drive towards the development of more active and selective catalysts.