Understanding Nano Confinement Effects in Catalysis

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Catalysis, as a key and enabling technology, plays an increasingly important role in fields ranging from energy, environment and agriculture to health care. Rational design and synthesis of highly efficient catalysts has become the ultimate goal of catalysis research. Thanks to the rapid development of nanoscience and nanotechnology, and in particular a theoretical understanding of the tuning of electronic structure in nanoscale systems, this element of design is becoming possible via precise control of nanoparticles' composition, morphology, structure and electronic states. At the same time, it is important to develop tools for in-situ characterization of nanocatalysts under realistic reaction conditions, and for monitoring the dynamics of catalysis with high spatial, temporal and energy resolution. In this talk, I will discuss confinement effects in nanocatalysis, a concept that we has put forward and developed over several years, and the emphasis will be laid on the development of the novel nano-materials as catalysts for energy processes. Taking the confined catalytic systems of carbon nanotubes (CNTs), metal-confined nano-oxides, two-dimensional (2D) layered nano-catalysts and nano composite as the examples, we summarize and analyze the fundamental concepts, the research methods and some of the key scientific issues involved in nanocatalysis. The important applications of such materials in catalytic conversion of methane and syngas to valuable chemicals will be introduced, as the examples.

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