Synthetic Silicate Supports for Nanoparticles of Unique Morphology

Principal Investigator: K. A. Carrado

- The patented synthetic silicate supports developed in the Catalyst Design Group (CHM) have been demonstrated as active hydrodesulfurization catalysts when cobalt-molybdenum-sufide nanoparticles are deposited on them. These CoMoS species are revealed by transmission electron microscopy to be of a unique multilayered morphology as opposed to the traditional dispersed monolayers (see figure). Reference: "HDS & Deep HDS Activity of Co/Mo/S-Mesostructured Synthetic Layered Silicates", K. A. Carrado, C. Song, J. H. Kim, N. Castagnola, R. Fernandez-Saavedra, C. L. Marshall, M. M. Schwartz, *Catalysis Today*, **2006**, 116, 478-484.

- In addition to the metal sulfide nanoparticles above, the same supports have been also demonstrated to have an effect on the morphology of pure metal nanoparticles, in particular, platinum. While some of the supports cause typical spherical Pt(0) morphology, a synthetic clay derived from silica sol leads to a unique Pt(0) raft-like morphology of 2 x 10 nm average size (see figure).

- Metal oxide nanoclusters are also under investigation in this program. Preliminary successive atomic layer deposition cycles indicate that small vanadium oxide nanoclusters may form on randomly dispersed surface silanol groups. The silanols result from incomplete condensation during the sol-gel hydrothermal crystallization of the synthetic silicate.

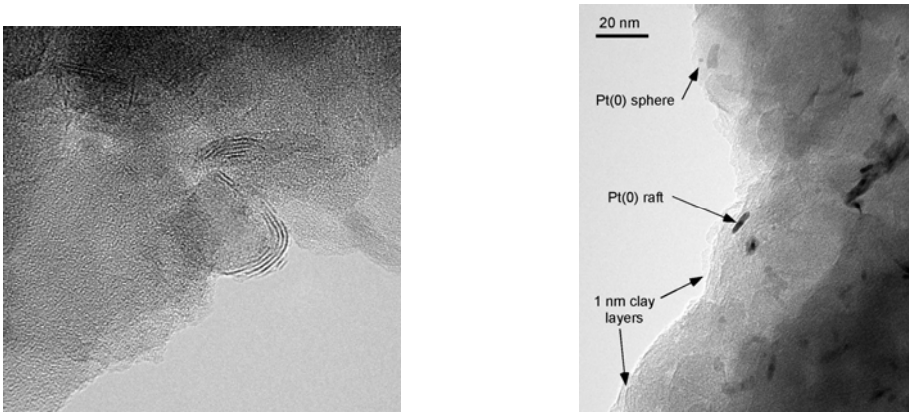

Figure: Unique morphologies for various metal species on synthetic silicate supports as revealed by TEM. On the left, multilayered banded structures are evident for metal sulfide particles; on the right, 2 x 10 nm rafts of Pt(0) occur, in contrast to the more often observed spherical shape.