

Chemistry at the Nanometer-Scale: Synthesis and Catalytic Characterization

Rationale: Synthesis and understanding of fundamental relations between the structure and functionality of nanostructured materials require complex, and sometimes unique, facilities and expertise. This project is designed to initiate a program for the development of such methods focusing on fabrication of well-defined, novel nanostructured materials with the objective of improving their catalytic functionality. One of the obvious advantages of so-called nanoscale catalytic systems resides in their exceptionally high surface-to-volume ratio, but other important attributes include: inherent size-dependent catalytic activity; richness in edge functional atomic groups; and shape selectivity. *Well-defined* nanocrystalline and nanoporous materials are in a great demand because of their fine-tuned electronic structure that defines their major functions, such as reactivity, catalytic selectivity, affinity to specific chemicals, etc.. These important attributes reveal themselves to the largest degree at nanoscale. The studies of this project will focus on synthesis of nanomaterials that are highly uniform in function. To this end, there have been assembled a complementary group of experimental and theoretical scientists that will concentrate on understanding synthesis of nanostructured materials and the underlying nanometer-scale phenomena occurring and affecting their chemical (catalytic) reactivity.

Objectives. The objectives of this project are to:

- (i) develop experimental techniques and fundamental theoretical concepts of controlled synthesis of inorganic (metallic and non-metallic) nanostructured materials i.e. preparation of uniform nanocrystalline/nanoporous materials;
- (ii) using the above methods, to determine the role of the inherent structural and catalytic properties of synthesized nanomaterials in shaping their functional characteristics (such as catalytic ability);
- (iii) on the basis of the above methods, to develop a detailed description of the fabrication techniques and technological recommendations of synthesis of several specific nanocatalytic systems.