Control of Nanostructures Via Metal-Carbon Interactions Over Multiple Length Scale Via Metal and Metal Carbide Nanojunctions and Nanowelds

NSF NIRT Grant 0103585
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This proposal was received in response to Nanoscale Science and Engineering (NSE) solicitation, NSF-00-119, in the category Nanoscale Interdisciplinary Research Teams (NIRT).

The main technical theme of this research is to undertake an interdisciplinary study (chemical engineering, physics and chemistry) of the structuring and restructuring of nanophase carbons, including nanoporous carbons, nanotubes, nanoropes, C60 fullerene and MetCars and the nanoscale processes leading to control of specific metal-carbon interactions. The main purpose is to study rearrangenment of amorphous carbons into nanocrystalline domains by the action of alkali and transition metals, welding of carbon nanotubes to one another through the formation of metal carbide nanojunctions and other metallic nanowelds, bonding of three dimensional structures consisting of vertically and horizontally oriented carbon nanotubes oriented orthogonally and welded through the metal-carbide nanojunctions, and the fabrication of monolithic metal carbide membranes with regular, uniform and aligned pores (vias) through the bulk normal to the average macroscopic membrance surface. The near term intellectual products of this research will lead to novel nanofabrication processes and to unique nanomaterials that can be used for electronic, mechanical and chemical applications.

The direct products of this research will be new physics, new chemistry, and new materials nanofabrication processes. The students trained in these interdisciplinary nanomaterials areas will be highly competitive in the nanoscience and -technology based industrial job markets of nanomedicine, nanoelectronics and nanochemical structures and processes. This grant is being co-funded by the Solid State Chemistry, Ceramics and Metals Programs of the Division of Materials Research, and the Kinetics, Catalysis and Molecular Processes Program of the Division of Chemical and Transport Systems.