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Final Report

International Symposium on Clusters and Nano-Assemblies: Physical and Biological Systems

The International Symposium on "Clusters and Nano-Assemblies: Physical and Biological Systems" was held in Richmond, Virginia from November 10-13, 2003. The symposium dealt with the fundamental science and technology of atomic clusters, nano-structures and their assemblies in physical and biological systems. The manner in which finite size, low dimensionality and reduced symmetry affect the properties of nano-assemblies was explored. While the field of clusters and nano-structures in physical sciences has been actively pursued over the past two decades, nature has known the benefit of nano-scale for a very long time. The focus of this symposium was to explore ways by which an understanding of unique properties of nano-scale biological systems such as proteins, enzyme reactions, RNA, and DNA can help us design novel materials composed of inorganic nano-scale systems in physical sciences. Similarly, how the techniques developed in physical sciences can lead to a fundamental understanding of biological systems were explored. The study of proteins in the gas phase through electrospray ionization mass spectroscopy, for which Professor John Fenn of Virginia Commonwealth University won the 2002 Nobel Prize in Chemistry, is an example of how the interface between the physical and biological sciences can lead to major breakthroughs.

In addition to assessing current understanding of these fields, outstanding problems and future directions were brought into focus. For example, how does one proceed from knowing the novel properties of isolated clusters and nano-particles to materials where these constitute the building blocks? How does one make use of the nature's creation such as enzymes to synthesize inorganic nano-structures with unique functionality that never existed in nature? The synergism produced by bringing together researchers working on surfaces, interfaces, clusters, and nano-structures in physical and biological sciences helped to answer some of these questions. The impact of these materials on technology was also discussed.

The topics included:

Synthesis, nucleation, growth, characterization, atomic and electronic structure, dynamics, ultra-fast spectroscopy, stability, electrical, magnetic, optical, thermodynamic, and catalytic properties of:

Clusters:	Free and supported
Cluster Materials:	Self-assembled, ligated, and embedded
Nano-structures:	Quantum dots, wells, and corrals; nano-tubes and wires
Bio-systems:	Protein, Enzyme reactions, RNA, DNA, Supra-molecular assemblies, biointerfaces, bio-hybrid devices

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Nano-Technology: Spintronics; magnetic, optical, and bio-sensors; catalysts; molecular electronics; drug delivery, bio-chips

This interdisciplinary symposium drew participants and speakers from Physics, Chemistry, Biology, Materials Science, and Chemical and Electrical Engineering. 196 participants from 12 countries attended this symposium. A total of 157 papers (42 invited and 115 contributed) were presented. The keynote session was addressed by two Nobel Laureates: Prof. John B. Fenn of Virginia Commonwealth University and Dr. William D. Phillips of the National Institute of Standards and Technology. This symposium was sponsored by the American Physical Society, ASM international, IEEE, Materials Research Society, The Minerals, Metals & Materials Society and as a topical
meeting. The symposium was supported by Air Force Office of Scientific Research, Army Research Office, Department of Energy, National Science Foundation, Nano-Va, National Aeronautics and Space Administration, Philip Morris USA, and Virginia Commonwealth University.