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Center for Integrated Nanotechnologies

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The Center for Integrated Nanotechnologies (CINT) is a Department of Energy/Office of Science Nanoscale Science Research Center (NSRC) operated as a partnership between Sandia and Los Alamos National Laboratories as a national user facility devoted to establishing the scientific principles that govern the design, performance, and integration of nanoscale materials. CINT is one of five NSRCs affiliated with major facilities at the DOE's National Laboratories across the U.S., that are envisioned to cover the diverse aspects of nanoscience and technology. The NSRCs aspire to become a cornerstone of the nation's nanotechnology revolution, contributing to DOE's principal missions in national defense, energy, and the environment while providing an invaluable resource for universities and industries. Through its core facility in Albuquerque with gateways to both Los Alamos and Sandia national laboratories, CINT provides open access to tools and expertise needed to explore the continuum from scientific discovery to the integration of nanostructures into the micro- and macro world.

CINT's vision is to become a world leader in nanoscale science by developing the scientific principles that govern the design, performance, and integration of nanoscale materials. The distinguishing characteristic of CINT is its emphasis on exploring the path from scientific discovery to the integration of nanostructures into the micro and macro worlds. This pathway involves the experimental and theoretical exploration of behavior, the development of a wide variety of synthesis and processing approaches, and an understanding of new performance regimes, testing design, and integration of nanoscale materials and structures. Integration itself is key to the exploitation of nanomaterials, and the scientific challenges that it poses are at the heart of CINT's mission.

Construction of the CINT Core and Gateway facilities is nearly complete. The CINT Core Facility will feature low vibration for sensitive characterization, chemical/biological synthesis labs, clean room for device integration, interaction areas and conference rooms, visitor office space, and high-speed communications. The CINT Gateway to Sandia will focus on nanomaterials and microfabrication from the existing Integrated Materials Research Laboratory (IMRL), while the CINT Gateway to Los Alamos will focus on biosciences and nanomaterials. All facilities will house state-of-the-art equipment.

CINT has identified five research themes that serve as integrated synergistic research thrusts. The Nanophotonics and Nanoelectronics thrust addresses the overall scientific challenge of understanding and controlling fundamental photonic, electronic and magnetic interactions in nanostructured materials. Science issues of particular interest to this thrust include: (1) Fundamental physics of nanoscale electronic, optical and magnetic phenomena; (2) Nanostructured materials growth and fabrication; (3) New tools to measure electronic, magnetic and optical properties of nanostructured materials. The Nano-bio-micro Interfaces thrust area focuses facilities and expertise at the intersection of nanoscale materials science and biological or biomolecular science. Science issues of particular interest to this thrust include: (1) Biologically-inspired energy manipulation; (2)

Multi-scale approaches for transduction of molecular events; (3) Control of passive and active assembly involving biological components; (4) Materials-based ultrasensitive characterization of biological systems and components. The Nanomechanics thrust focuses on scientific problems involving the mechanics of nanostructured and nanoscale materials, the interaction of mechanical systems or mechanical strain with biological, electrical, and optical systems, the transduction of electrical, chemical, and magnetic energy to mechanical actuation, the synthesis of nanostructured and nanoscale materials, the synthesis of micro- and nanoscale mechanical devices, and the characterization of the mechanical behavior of these materials and devices. Science issues of particular interest to this thrust include: (1) Transduction of mechanical work at the nanoscale; (2) Mechanical properties of nanostructures and nanosystems; (3) Mechanics of Nanoscale Biomimetic Materials. The Complex Functional Nanomaterials (CFN) Thrust focuses facilities and expertise in materials synthesis, interfacial science, self-assembly, advanced characterization, and theory to obtain fundamental understanding of structure/function/property relationships over multiple length and time scales. Science issues of particular interest to this thrust include: (1) Rational nanomaterials synthesis; (2) Nanoscale materials characterization; (3) Nanoscale inhomogeneities in bulk materials. The Theory and Simulation thrust is focused on the interplay between quantum and classical processes at nano- meso- micro- length and time scales. The thrust strives to provide unified descriptions of relevant energy, mechanical, optical, electronic and chemical processes in hard, soft and biological systems that address multiscale functions of these systems. Science issues of particular interest to this thrust include: (1) Energy transfer processes and mechanisms at nanoscale; (2) Self-assembly – correlation between process, self-assembled structure, and properties; (3) Modeling materials interfaces and free surfaces; (4) Impacts of advanced visualization capabilities.

In addition to the scientific thrusts, a distinguishing feature of CINT are its Discovery Platforms™ – modular, micro-laboratories designed and batch fabricated expressly for the purpose of integrating nano and micro length scales and for studying the physical and chemical properties of nanoscale materials and devices. Discovery Platforms ™ will be standardized and packaged in a way that allows easy connections with external electrical, optical, and fluidic devices. The design and packaging will also allow direct access for a wide range of external diagnostic and characterization tools available at the Center for Integrated Nanotechnologies (CINT). Platforms planned for deployment in 2006 include the Cantilever Array Discovery Platform™, Electrical Transport and Optical Spectroscopy Discovery Platform™, and Microfluidic Synthesis Discovery Platform™.

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