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Active, Hybrid, and Horizon Nanomaterials

The interaction of nanoparticles with electromagnetic fields or other stimuli can introduce new processes such as photo- or electrocatalysis. Semiconducting materials often facilitate separation of charge, leading materials with intrinsically low chemical toxicity to create new toxicants such as reactive oxygen species. Many emerging approaches to photovoltaic/photocatalytic energy conversion and storage make use of more complex nanostructures that integrate multiple components and heterojunctions, in part to enhance charge separation and/or to stabilize the materials mechanically. Nanoscale complex metal oxides and Group IV semiconductors are seeing rapidly expanding utility as cathode and anode materials for lithium ion batteries. These represent emerging classes of nanomaterials that involve alloys and/or solid solutions of different composition, with redox potentials varying by several volts depending on the extent of lithiation-delithiation. As battery use in transportation and in consumer electronics increases, routes of exposure to these nanoscale materials increase markedly. The increasing structural and physical complexity of technologically relevant nanomaterials highlights a continuing need to identify and understand the fundamental design rules that govern how different classes of nanomaterials interact with the environment and with biological systems. While most nanoparticles undergo chemical and physical changes, there remains a continuing need for stable nanoparticles that can be used to characterize nanoparticle transport and interactions in the environment. Nanodiamond represents one such emerging ultra-stable material that has the potential to act as a stable tracking particle in the environment.

Robert Hamers Bio:

- Professor of Chemistry at the University of Wisconsin-Madison (1990-present). Formerly at IBM T.J. Watson Research Center (1985-1990).
- Research interests focus on surfaces and interfaces of nanomaterials relevant to renewable energy and environmental science. Particularly strong emphasis on semiconducting materials, electron-transfer and photo-initiated surface processes.
- Director of the Center for Sustainable Nanotechnology, an NSF Phase I Center for Chemical Innovation .
- Co-leader of the UW-Madison NSEC effort on Environmental Health and Safety Implications of Nanotechnology.