Green chemistry can make nanotechnology mature, UO professor says

by Bend_Weekly_News_Sources

Hutchison aims to reduce environmental and health concerns

The safest possible future for advancing nanotechnology in a sustainable world can be reached by using green chemistry, says James E. Hutchison, a professor of chemistry at the University of Oregon.

"Around the world, there is a growing urgency about nanotechnology and its possible health and environmental impacts," Hutchison said in his talk Feb. 18 during a workshop at the annual meeting of the American Association for the Advancement of Science. "There is a concern that these issues will hinder commercialization of this industry."

Nanotechnology refers to research on materials that are nanometer in size - or about 1 billionth of a meter and applicable to virtually every technology and medicine. The field of nanoscience, Hutchison said, is still in the discovery phase, in which new materials are being synthesized for testing for very specific physical properties. During such work, there often are unintended properties of material that potentially can be hazardous to the environment or human health but are, for now, an acceptable risk in secured research environments, he said.

In an earlier session, Vicki Colvin, professor of chemistry and chemical engineering at Rice University in Houston, had echoed similar comments but concluded that nanotechnology can be safe by proceeding with an approach she called "safety by design." Barriers to engineering safe nanoparticles, she said in her topical lecture, include testing for toxicity of materials already produced built around a policy to manage risks and doing fundamental basic research to address such things as purification of nanomaterials and surface areas where nanoparticles and proteins come together. She said extensive libraries of nanoparticles are needed to help assure safety.

As nanoparticles decrease in size, Colvin said, they have special unique properties. "At what point does size become a barrier?" she asked. Another safety issue is in the exposure to nanoparticles through inhalation and skin contact.

In his talk, Hutchison focused on what he called a proactive approach to advancing from the current discovery phase in the creation of nanomaterials into a production phase that is efficient and reduces waste. He suggested a green framework for moving the industry forward.

Now is the time, Hutchison said, for scientists to "seriously consider the design of materials, processes and applications that minimize hazard and waste, and this will be essential as nanoscience discoveries transition to the products of nanotechnology."

Hutchison is a leading U.S. innovator in nanofabrication and assembly processes and is a pioneer in the use of green chemistry, which he also teaches to other scientists around the country at workshops. He also is the leader of the Safer Nanomaterials and Nanomanufacturing Initiative, which is funded by an Air Force Research Laboratory grant to the Oregon Nanoscience and Microtechnologies Institute.

Green chemistry, he argues, can sharply reduce the use of toxic solvents and produce safer products with reduced chances for unintended consequences. It also can provide opportunity for new innovations. "Green chemistry allows us to think about new space and new parameters," Hutchison said. "We have the opportunity to develop the technology correctly from the beginning, rather than trying to rework an entrenched technology."

Such an approach, he said, contributed to public opposition to genetically modified crops. Colvin, in her talk, also referred to the backlash against genetically modified organisms, as well as the unintended impacts of DDT (toxicity to animals), some pesticides (cancer in humans) and refrigerant (ozone destruction).

Hutchison, who is director of the UO's Materials Science Institute, is developing diverse libraries of nanoparticles, such as those called for by Colvin. In his UO lab, Hutchison said, "We systematically bury the structural parameters and use in vivo and in vitro assays to determine the relationship between biological response and structural parameters."

One such library covers gold nanoparticles for use in basic research. By studying these nanoparticles, he said, researchers can get an idea of what kinds of new electronic, optical and pharmaceutical products eventually may come to market. Hutchison received a patent in 2005 for his synthesis of gold nanoparticles using green chemistry.

Hutchison told the AAAS gathering that he recently published a technique for purifying nanoparticles that uses membranes with nanopores so small that only impurities pass through - a green approach that allows the purification of particles rapidly without using organic solvents. "Before this accomplishment, purifying the material used up 15 or so liters of solvent per gram of particles," he said. "If solvent is the density of water, that's 15,000 times more mass used to purify it than we get out of it."

The nanotechnology industry, Hutchison said, has reached an important moment in time. "There is an opportunity to stay ahead of the curve," he said. "We should commit ourselves to design these materials and processes to be green from the beginning, and this will provide a lot of freedom from layers of regulation to researchers and companies, allowing for more innovation."