Nanomaterials May Have Large Environmental Footprint

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(PhysOrg.com) -- Environmental gains derived from the use of nanomaterials may be offset in part by the process used to manufacture them, according to research published in a special issue of the *Journal of Industrial Ecology*.

According to a paper by Hatice Şengül and colleagues at the University of Illinois at Chicago, strict material purity requirements, lower tolerances for defects and lower yields of manufacturing processes may lead to greater environmental burdens than those associated with conventional manufacturing. In a study of carbon nanofiber (CNF) production, Vikas Khanna and colleagues at The Ohio State University found, for example, that the life cycle environmental impacts may be as much as 100 times greater per unit of weight than those of traditional materials, potentially offsetting some of the environmental benefits of small size of nanomaterials.

Materials engineered at dimensions of 1 to 100 nanometers (1 to100 billionths of a meter) exhibit novel physical, chemical and biological characteristics, opening possibilities for stunning innovations in medicine, manufacturing and a host of other sectors of the economy. Because small quantities of nanomaterials can accomplish the tasks of much larger amounts of conventional materials, the expectation has been that nanomaterials will lower energy and resource use and the pollution that accompanies them. The possibility of constructing miniature devices atom-by-atom has also given rise to expectations that precision in nanomanufacturing will lead to less waste and cleaner processes.

“Research in this issue reveals the potential of environmental impacts from nanomanufacturing to offset the benefits of using lighter nanomaterials,” saysGus Speth, dean of the Yale University School of Forestry & Environmental Studies. “To date, most attention has focused on the possible toxic effects of exposure to nanoparticles and appropriately so. But the ‘old-fashioned’ considerations of pollution and energy use arising from the production technologies used to make nanomaterials need attention as well.”

Other topics explored in the special issue include:

· Approaches for identifying and reducing the life cycle hazards of nanomaterials
· Quantified life cycle energy requirements and environmental impacts from nanomaterials
· Tradeoffs between nanomanufacturing costs and occupational exposure to nanoparticles
· Efficiency of techniques for nanomaterials synthesis
· Improvement of the sustainability of bio-based products through nanotechnology
· Industrial frameworks for responsible nanotechnology
· Industrial and public perception about the risks and benefits of nanomaterials
· Governance and regulation of nanotechnology

Industrial ecology is a field that examines the opportunities for sustainable production and consumption, emphasizing the importance of a systems view of environmental threats and remedies. “Through the use of tools such as life cycle assessment, green chemistry and pollution prevention, industrial ecology takes a broad and deliberate view of environmental challenges,” states Reid Lifset, editor-in-chief of the Journal of Industrial Ecology. “This special issue shows the power of this approach.”

Roland Clift, Professor of Environmental Technology in the Centre for Environmental Strategy at the University of Surrey and Shannon Lloyd, Principal Research Engineer in the Sustainability & Process Engineering Directorate at Concurrent Technologies Corporation, served as guest editors. Support for this special issue was provided by the Educational Foundation of America, in Westport, Conn. and the Project on Emerging Nanotechnologies of the Woodrow Wilson International Center for Scholars in Washington, D.C.

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