Using Nanomaterials to Filter Clean Drinking Water

CHRISTOPHER J. DURNING

Professor of Chemical Engineering

Clean drinking water is something most of us take for granted. But many people around the world do not have access to clean water and the problem is only going to get worse in coming years, as populations increase and the water supply becomes more scarce. Researchers, including Christopher J. Durning, are working on improving the decontamination of water, in particular on developing ways—at lower cost and using less energy—to safely use wastewater and to desalinate sea and brackish water.

A current project Durning is working on is developing better filtration membranes for both the reuse of wastewater and the efficient desalination of sea and brackish water. In a project funded by the Pall Corporation, a leading manufacturer of water purification systems, Durning and his team are modifying the surfaces of ultra-filtration membranes with ultra-thin polymer/nanoparticle coatings to enable nanofiltration (NF) and/or reverse osmosis (RO) performance. "This surface modification method we use, layer-by-layer deposition, is a directed self-assembly process, and provides outstanding control of the surface layer architecture and chemistry," said Durning, adding that the resulting new NF and RO membranes will expand the range and capability of membranes useful for production of potable water via wastewater treatment and desalination. "Our aim," he said, "is to contribute relevant technology for the impending 'water crisis'."

Durning's research focuses on exploiting "soft" materials in a variety of new applications through their manipulation at the nanoscale. This requires an understanding of the key factors that control their structure and dynamics. He studies transport and diffusion, surface and interfacial behavior in polymeric systems, and self-assembly processes in soft matter systems. He is particularly interested in nanostructured materials, which he says offer unique advantages in many applications, such as high-capacity magnetic storage media, ultra-small photonic and electronic devices, graded layers and films for super-mirrors and notch filters, and "labs-on-a-chip."

He and his team are currently working to develop new ways to generate nanostructures, such as well-ordered arrays of nanoparticles and nanorods, via supra-molecular chemistry and self-assembly. They are also working to exploit established self-assembly methods, to provide new materials, such as nanocomposites, nanoporous solids, and structured surface coatings, that help address compelling technological problems, such as natural gas refining, fuel cell development, water purification, and toxin detection.

"It's very satisfying to see what starts as an esoteric basic finding develop into a practical solution for an important technological problem," said Durning. "It is especially exciting that our work in membrane science could help supply one of the world's most basic needs—clean drinking water."

B.S., Columbia, 1978; M.A., Princeton, 1979; Ph.D., Princeton, 1982