NanoCeram Nanoalumina Fiber

The advent of the NanoCeram nanoalumina fiber represents a breakthrough in filtration technology.

NanoCeram fibers are alumina ceramic fibers about 2 nanometers in diameter and 50 to hundreds of nanometers long. NanoCeram fibers have a far higher aspect ratio (ratio of radius to length) and a far greater surface area (up to 600 m2/gm) than any other available fiber. They can be manufactured easily and inexpensively, and their functionality can be tailored to specific applications. These properties, along with the tendency to become charged at an appropriate pH, makes the fibers ideal for bioactive filtration, chemisorption of heavy metals, and bone tissue engineering.

As a bioactive filter, NanoCeram fibers can eliminate 99.99999% of many viruses, bacteria, and microbial pathogens in a single pass while retaining high flow rates compared to membrane based filters. The pathogens that NanoCeram can be used to eliminate include (but are not limited to) hepatitus A, retroviruses, adenoviruses, coxsackie, Salmonella, Shigella dysenteriae, E. coli 0157:H7, Vibrio cholerae, B. anthracis, and Cryptosporidium parvum. Three characteristics make the fibers ideal for bioactive filtration:

- Chemisorption. In the pH range in which the fibers are used as a filter, viruses and bacteria tend to be negatively charged (acidic) while the fibers tend to be positively charged (basic). Thus, in close proximity, fibers and pathogens form chemical bonds, which filters pathogens from the stream. Plus, the large fiber surface area provides numerous sites at which pathogens can bond.
- Physisorption. Pathogens and fibers also experience physical attraction for each other via Van der Waals forces – attractive forces that exist between particles at very close range.
- Mechanical Trapping. The fibers act as a depth filter with random-size pores. As pathogens pass through the filter, they become enmeshed in the tangle of pores.
- Self-cleaning. Fibers can be coated with TiO_2 allowing the fibers to be cleaned in the presence of UV light.

A thin bed of NanoCeram can remove more than 99.99% of heavy metals such as lead, arsenic, and chromium from water in a single pass, reducing the metal in the effluent to parts per billion. Arsenic contamination of potable water is a worldwide health issue and with the new U.S. arsenic water standards going into effect in 2006, the need for an effective, inexpensive water filter will be great. Since the NanoCeram fiber technology can be scaled-up, it can be used for filters at the point of production (municipalities) to point of consumption (residential).For bone tissue engineering, NanoCeram provides a strong fibrous scaffolding to which bone-forming osteoblast cells can adhere and grow. Trials indicate that NanoCeram fibers promote the bonding and growth of osteoblast cells better than other materials, including hydroxyapatite – the calcium-containing mineral that is a component of bone.

Hybrid thin-film photovoltaic (PV) cells have been produced using a organic polymer and ZnO nanofibers. Initial cells have an efficiency of about 0.5%, the current generation of organic PV cells have an efficiency of about 3%. With silicon prices increasing 60% over the past two years due to a shortage of PV grade silicon, organic or hybrid PV cells have the potential to be a cost effective alternative to silicon based PV cells.

Besides these applications, NanoCeram also has other potential uses, including catalyst support, protein separation, air-filtration, filtration of high-purity chemicals, and composite materials.

The value proposition for this technology is that NREL's NanoCeram is cost-effective, enhanced performance characteristics, and has many applications.

Licensing Our Technology
NREL is looking for a strategic alliance to develop and commercialize this technology. The alliance could be a license, a Cooperative Research and Development Agreement (CRADA), or a Work For Others (WFO) that leverages NREL's unique capabilities, facilities, and personnel.

Contact Information
If you would like to explore collaborative opportunities with the National Renewable Energy Laboratory please contact Richard Bolin, 303-275-3028 or via email at richard_bolin@nrel.gov.

Also for more technology transfer opportunities visit our Web site at www.nrel.gov/technologytransfer.