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. These properties, along with the tendency to become basic in appropriate pH solution, 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 of fluid through the filter. 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.

A thin bed of NanoCeram can remove more than 99.99% of heavy metals from water with a single pass through the filter, and reduce the metal in the effluent to parts per billion. Because of the large external surface area, NanoCeram has rapid sorption kinetics, enabling the material to adsorb a large amount of dissolved heavy metals in a short period of time.

For bone tissue engineering, NanoCeram provides a strong fibrous material, molding a scaffolding to which bone-forming osteoblast cells can adhere and build. Trials indicate that NanoCeram fibers promote the bonding and growth of osteoblast cells better than other materials, including hydroxyapatite – the calcium containing mineral that, with the protein collagen (the fibrous part of tendons and ligaments), forms the bone material.

Besides these applications, NanoCeram also has other potential uses, including catalyst support, biosynthesis substrate, protein separation, blood plasma purification, filtration of vents and exhaust, and filtration of highpurity chemicals.

The value proposition for this technology is NREL's NanoCeram is more cost-effective, allows increased performance, 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 by email at richard_bolin@nrel.gov.

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