Advanced Self-Indicating Material Filters Particles, Toxic Gases, and Microbes

Air quality is essential to human health and sustainable industrial processes. Air pollutants of concern include particulate matter; toxic, odorous, and corrosive gases; and microbes. While filtration methods are available to remove particulate matter from the air, effective techniques for filtering chemicals and microbes remain elusive. Moreover, users cannot tell if existing filters are working properly or have reached the end of their working life.

Serionix, a Champaign, IL-based startup, has developed a material that captures particulate matter, toxic gases, and microbes. Called TraceSorb, the new material is an ion-exchange fiber composite (IXFC) that combines filtration fibers with a polyelectrolyte-based coating to remove odorous and toxic gases from the air and kill microbes. And, TraceSorb filters change color to indicate when they need to be replaced.

The IXFCs have a larger exposed surface area than conventional granular filtration media, increasing media contact with air. Low-cost materials and a simple manufacturing process make the technology less expensive than the nonwoven materials impregnated with activated carbon that are commonly used in high-end industrial applications. Furthermore, unlike activated carbon — in which the adsorption and surface reactions occur out of sight of the user — TraceSorb's reactive surface is visible, enabling the color-indicating feature to show the user the remaining useful life of the filter.

▲ Serionix president, James Langer, holds new (purple) and used (yellow) TraceSorb filters. The color change and chemical and odor removal are made possible by Serionix's proprietary ion-exchange fiber composite (IXFC). Image courtesy of Robin Schulz, *The News-Gazette*.

With funding from the National Science Foundation Small Business Innovation Research (SBIR) program, Serionix has turned an idea developed during two decades of research on high-performance materials for air and water purification at the Univ. of Illinois into a commercial-ready product. The company is now operating an automated pilot-scale production facility with a capacity of 40 kg/day of IXFC filtration material and is testing prototypes for several markets.

One industrial application that could benefit from the TraceSorb technology is microelectronic chip manufacturing, where airborne molecular contaminants (AMCs) frequently cause processing issues. At trace levels, in the parts-per-billion (ppb) or parts-per-trillion (ppt) range, AMCs greatly reduce yield and may cause extensive damage to equipment and downtime losses on the order of $10,000/hr.

Consumer applications could also benefit from the new technology, as TraceSorb addresses a growing concern about the link between health and indoor air quality. Serionix is testing TraceSorb in homes to reduce pet odors. During the past eight months,

▲ More than 20 cat owners have evaluated the new filters, and over 90% reported they were satisfied with them.

more than 20 cat owners have evaluated the new filters, and over 90% reported they were satisfied with them. Their positive feedback and inquiries to buy more filters have encouraged the company to pursue this market in earnest.

Serionix's technology represents a filtration platform that can address air filtration challenges in applications as diverse as microelectronics manufacturing cleanrooms and the homes of pet owners.

"TraceSorb's visual indication of filter life puts critical knowledge in users' hands, solving the ubiquitous challenge of determining filter life with an intuitive, straightforward cue," says Weihua Zheng, co-founder and vice president of Serionix. "While filtration is currently an abstract concept for most consumers, we believe our technology will help create a fundamentally deeper level of understanding, engagement, and investment in indoor air quality and filtration."

TraceSorb has attracted the attention of leading players in the heating, ventilation, and air conditioning (HVAC), automotive cabin air filtration, fuel cells, aerospace, and other sectors. CEP

This technology was funded through the NSF Small Business Innovation Research Program.

This article was prepared by the National Science Foundation in partnership with *CEP*.