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Biohazard Detection Made Simple with a Newly Developed Cloth

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Nanotechnology is leading the way in the production of new techniques and products that will advance the level of protection in food safety, health services, and homeland security.

Scientists at Cornell University, in Ithaca, New York, have developed a cloth that has the potential to detect bacteria, viruses, and other biohazards. The newly developed non-woven fabric could revolutionize how biohazards are detected and add a new layer of protection from the home to the homeland.

New Applications from a New Science

The cloth is a product that evolved with the development of a new and emerging field of science, nanotechnology. Nano refers to the size of the products developed in this field. The smallest conventional textile fibers have diameters of approximately 10 microns (μ) or 10,000 nanometers (nm), but the fibers created using this new process have diameters ranging from 2 – 100 nm, several orders of magnitude finer. The fibers in the new cloth are produced from polylactic acid (PLA), polyester made from corn starch rather than petroleum, by Natureworks, LLC. Using a process called electrospinning, the polymer is spun into fibers and constructed into cloth.

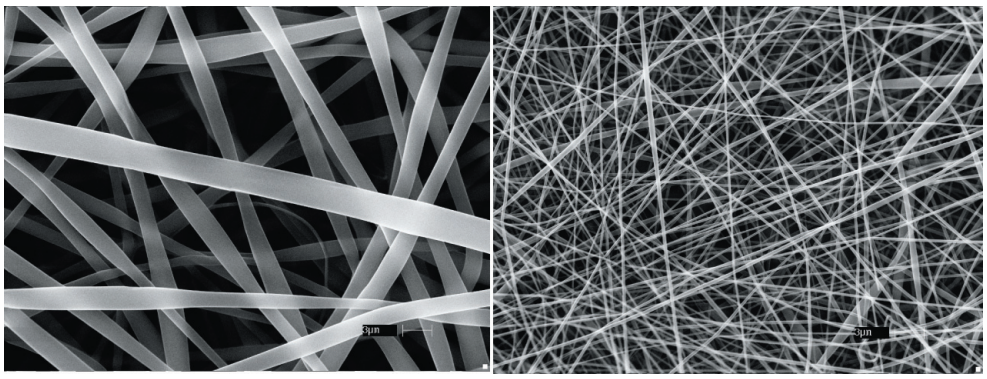

Figure 1. Fibers produced at room temperature (left) have larger diameter and result in a fabric with larger pores than fibers produced at higher temperatures (right). (Frey, 2006)

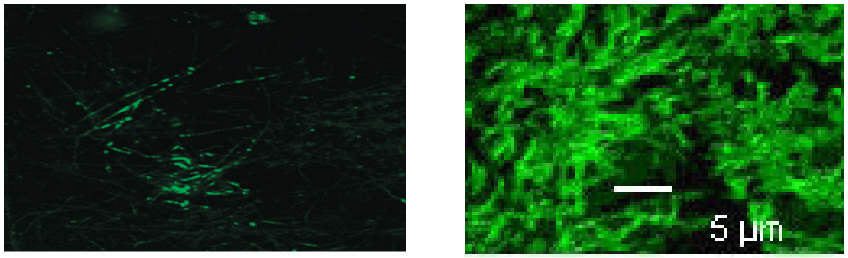

Figure 2: Fluorescence labeled anti-*E. coli* antibody captured on a fabric with biotin, incorporated from suspension (left) or solution (right) with PLA, during the electrospinning process. (Frey, 2006)

Scientists compare the new cloth to a sponge because the fine nanoscale fibers enhance the cloth's surface area and absorbency. The effectiveness of this cloth for biohazard detection lies within the fibers themselves. During the electrospinning process, biotin, a reactive component of the B vitamin complex, is incorporated into the PLA fibers. Biotin acts as an attachment site for the streptavidin protein, which can react with up to three agents, activating the fabric to capture the targeted biohazards. The technique is effective because the streptavidin complex binds with specific biohazards. To aid in visualizing detection, the fibers contain liposomes that release a dye when contact with a biohazard is made. The use of liposomes allows the confirmation of biohazard detection with the naked eye. The resulting fabric can be used as an easy-to-handle swab or wiper capable of picking up and identifying biohazards on surfaces or in liquids.

Potential Applications

Development of the biodetection cloth was made possible through funding provided by the National Research Initiative Nanoscale Science and Engineering for Agriculture and Food Systems program. Potential uses for this new product are numerous. The Department of Homeland Security could apply the new technology to screen for biohazards, such as the anthrax virus. The cloth could also be used by the health care community to confirm the removal of pathogens in operating rooms. The Centers for Disease Control and Prevention could apply the new technology to identify the presence of viruses, such as avian influenza. Finally, food preparation facilities could rapidly screen for common contaminants, such as *E. coli* or Listeria. Although this test would not provide as much information as a full biochemical analysis, it could provide a rapid response test that could be performed by personnel without highly specialized training or equipment. The future applications of this product are limitless and provide exciting new opportunities to keep people safe and healthy.

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