Research Develops Process to Recycle Waste Cotton into High-Value Nanofibers. By Kathlyn Swantko

A Load off the Landfill

Among textile materials, cotton is the most abundantly produced natural fiber, with "more than 28 million tons of cotton produced worldwide each year," explains Dr. Addie Bahi, materials engineering research scientist at the University of British Columbia (UBC). "In addition, the recycling rate for cotton is estimated to be around five percent, significantly less than the overall textile recycling rate of 15 percent."

To address this issue, Dr. Bahi, along with Frank Ko, lead researcher in advanced fibrous materials and UBC Professor of materials engineering and their academic team, began their lab-scale project of converting cotton production waste and discarded cotton apparel into high-value nanofibers. Phase One of the project began in 2018, assisted by a BC-based ecologist, and a local manufacturer of outdoor apparel supplying the cotton fabrics. Financial support was provided by a grant from the Natural Sciences Engineering Research Council of Canada.

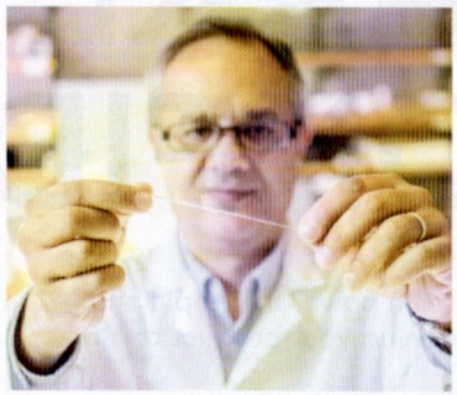
The focus of UBC's research is the development of a chemical process to convert the cotton waste into high-value nanofibers. To accomplish this, the waste cotton fabric was chopped into tiny strips and soaked in a chemical bath to remove all additives and artificial dyes from the fabric. The resulting gossamer-thin material was fed into an electrospinning machine, which produced very fine, smooth nanofibers. "While the process itself is relatively simple," cites Ko, "we are thrilled that we've been able to prove that a high-value product can be extracted from something that would normally go into a landfill where it would eventually be incinerated."

The pre-treatment of the cotton consists of a two-level treatment: A scouring process to remove impurities (i.e. oil, soluble impurities, and other chemicals) to produce a hydrophilic, clean cloth, and a bleaching process to whiten the textile and remove the dyes.

After removing the contaminants, the fabrics are ground into a fine powder, which can be dissolved and used for electrospinning, which is a non-mechanical technique used to create nanoscale fibers electrostatically from polymer solutions or melts, according to Bahi.

Project Goals

The ultimate goal is to replace the existing solvent lab process with an environmentally-friendly scaled-up version. While the team has limited its initial research to converting 100 percent cotton waste into nanofibers, future plans are to begin working on cotton blends and manufactured textiles as well. In recent years, the scientific importance of polymeric nanofiber, along with the technological and economical advances in nanocomposites, has caused an explosive growth in research activities on nanofibers.



Dr. Addie Bahi shows the value-added nanofiber created through UBC's new cotton waste conversion process. This represents one of the first successful attempts to make nanofibres from fabric scraps. For more information, contact: Dr. Addie Bahi at: addie.bahi@ubc.ca, 604-822-2676, or Frank Ko, frank.ko@ubc.ca, 604-822-2738.

Bahi states, "Due to the significant upside potential of chemical recycling methods, our research was done to determine the chemical recycling methods that are environmentally benign and economically viable. At this stage, our method is suitable for any 100 percent cotton fabric constructions. Going forward, we plan to modify our process for blends as well."

End-use applications that have high potential to be impacted by UBC's research include formation of nanocomposite fibrils and yarns: electroactive nanofibers for ultrahigh sensitive sensor/electrode applications; bioactive nanofibers for biomedical applications; and nanofibers that can convert and replace petroleum-based carbon fibers for lightweight structural applications. ●

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