Inherently Omniphobic Fibers and Fabrics (2016-025)

Modified fiber geometry and surface structure results in water, oil, and stain repellent fabrics

Market Overview

This fiber modification uses channels with re-entrant features in the shape of repeating trapezoids to create highly repellent textiles that resist attraction of both water and liquid chemicals, solvents, and oils. The self-cleaning textiles market, which includes hydrophobic, oleophobic, and omniphobic materials, is expected to reach a value of $573 million by 2021. Conventional textile surface chemistries rely on chemicals like fluorocarbons, silicones, and waxes to create omniphobic materials. To reduce the need for chemical modifications, researchers from Clemson and the Natick Solider Research Development and Engineering Center (NSRDEC) have developed a fiber structure that allows for omniphobic fabrics to be produced. By engineering the fabric surface to have trapezoidal shape nano-features, any liquid that comes in contact with the material simply rolls off the surface. This approach eliminates the need for conventional chemical surface coatings and instead modifies the fiber geometry and structure, resulting in water, oil, and stain repellent fabrics.

Technical Summary

Clemson and NSRDEC researchers have developed a fiber surface architecture that allows for inherently non-wetting fabric substrates to be created without the need for chemical modifications. This process modifies fiber geometry and its surface structure by first creating a bi-component fiber. Then the water-soluble component is extracted and a third level re-entrant fiber is introduced to achieve super liquid repellency. The introduction of a third level re-entrant on the fibers' surfaces is based on the addition of a dual hierarchical micro/nano-scale surface feature to an omniphobic fabric. The new fiber geometry eliminates the need for hydrophobic or oleophobic surface chemistries and results in excellent fiber extrusion control, fast fiber extraction, and excellent liquid repellency

Application
Fibers and fabrics; military

Development Stage
Proof of Concept and Prototype

Advantages
- Demonstrates excellent fiber extrusion control, allowing for faster fiber extraction

App Type	Country	Serial No.	Patent No.	CURF Ref. No.	Inventors
Provisional	United States	62/413,514	NA	2016-025	Dr. Philip Brown Quoc Truong Nicole Hoffman

About the Inventors

Dr. Philip Brown

Associate Professor of Materials Science and Engineering at Clemson University

Dr. Phil Brown earned his Ph.D. from the School of Textile Industries at the University of Leeds, England, UK. Prior to joining the Clemson faculty, Dr. Brown was a teaching and research fellow at Herriot Watt University and a lecturer at Leeds University. His research interests include the broader areas of dyeing and finishing, including self-cleaning fabrics and fibers, the crosslinking of synthetic fibers, and the application of UV laser radiation to textile substrates.

Quoc Truong

Physical Scientists, Warfighter Directorate, U.S. Army Natick Soldier Research

Quoc Truong earned his M.S. in Plastics Engineering from the University of Massachusetts, Lowell his M.S. in Engineering Management from Western New England University and has completed doctoral program coursework within the UMass Lowell's Plastics Engineering program. He has been a guest lecturer Philadelphia University. His current research includes: aerosol repellent/icephobic/superomniphobic coatings, fibers, and ultrathin R2R films, self-healing materials, multilayer CB elastomeric barrier materials, and novel closures/interfaces.

Nicole Hoffman

Textile Engineer for Battelle

Nicole Hoffman is originally from Danbury, Connecticut. She received her B.S. in Polymer and Fiber Chemistry with a minor in Chemistry from Clemson University in 2013. She continued on to receive her M.S. in Materials Science and Engineering under Dr.Phil Brown in 2016. Her research focused on the development of novel fibers through the manipulation of bicomponent melt spinning methods. She provides technical support for all areas of textile engineering for both Army and chemical/biological protective ensemble projects onsite at the U.S. Army Natick Soldier Research, Development and Engineering Center.

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