Internship Description

Title: Testing and Evaluation of Omniphobic Coated Fabrics for use in Self-cleaning and Chemical/Biological Protective Clothing

Hosts: Quoc Truong

Division: NSRDEC/WarSTAR/Materials and Defense Sciences Division

Location: Natick, MA

Description: An omniphobic material with a smooth surface is influenced by its surface chemistry, surface architecture, and local surface curvatures created by micro/nano cavities. An ideal omniphobic material has an apparent contact angle ($\theta_{\text{advancing}}$) >150° when in contact with water and organic solvents, a micro-/nano-roughness surface architecture, and local surface curvatures created by micro and nano cavities where liquid cannot wet the omniphobic treated surface. Whereas, an omniphobic textured textile surface’s nonwetting to liquids is influenced by its fibers’ surface chemistry ($\theta^*$) and surface texture; fabric weave opening and design; and individual fiber and bundles’ sizes.1

With the above findings, the main objective of this project is to identify and recommend an optimum fabric weave design(s) for use with an omniphobic coating to develop a fabric that would allow maximum comfort and resistance to liquid penetration when used in self cleaning and/or CB protective clothing. The approach in meeting the main objective will be to test and evaluate a series of omniphobic treated woven textiles* with different fabric geometry (e.g., weave constructions, pore size openings, and fiber density) for their resistance to liquid wetting and penetration (or robustness). Water and a few selected organic solvents [Octane, Hexadecane, & Dimethyl methyl phosphonate (DMMP)] will be used to examine the effects of having different fabric geometries have on the fabrics’ robustness in static (laid drop) and dynamic (falling drop) environment (i.e., with and without the presence of a hydrostatic pressure.)

An automatic tilt base goniometer will be used to measure and observe the changes in advancing, receding, and roll-off contact angles of water and above selected organic solvents on untreated and treated fabrics. Physical properties testing of standard and omniphobic coated fabrics will also be conducted. These will include weight, thickness, flexibility, tensile properties, spray rating, hydrostatic resistance, air permeability, water vapor permeability, launderability, other textile properties, scanning electron microscopy, and surface tension/contact angle measurements. This effort supports Task 6, “Superomniphobic Fabrics with CWA Repellent Chemistries" of the Integrated Protective Fabric System Program, which is being funded by the Defense Threat Reduction Agency (DTRA).

*The series of untreated and omniphobic treated fabrics will be available to this project.