PROTECTION - SCIENCE AND TECHNOLOGY ADVANCES FOR CHEMICAL AND BIOLOGICAL PROTECTION

Elastomeric, Omniphobic Composites for Protection Applications

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Current personal protective equipment (PPE), especially protective suits, relies on the use of perfluoroalkyl substances (PFAS) for repellency of chemical warfare agents (CWAs). As these chemicals are phased out due to environmental concerns, novel solutions are required for repellency. Furthermore, incorporation of active materials, such as metal-organic frameworks (MOFs), into textiles generally increases wetting behavior, therefore reducing repellency. This research aims to develop omniphobic textiles and barriers through the incorporation of polyhedraoligomeric silsesquioxane (POSS)-treated MOFs onto elastomeric films and fibers that are active towards CWA degradation. POSS molecules with various functionalities were screened. Several MOFs, including MOF-808, UiO-66-NH2, UiO -67, HKUST-1, and Cu-MOF-74, were successfully modified with POSS and their surfaces turned omniphobic. Next, we investigated various processing techniques, such as electrospinning, film drawing, and dip-coating, to determine the effects of processing parameters and order of treatment on wetting properties. The best-performing composites we obtained so far were dip-coated UiO-66-NH2/POSS polypropylene swatches that were able to repel water completely and HD up to 4 hours. We anticipate the fundamental understanding of the structure-activity-processing relationships we developed here will aid applied projects for optimal suit development.

This research is funded by DTRA ESCAPE program CB11222