PROTECTION - SCIENCE AND TECHNOLOGY ADVANCES FOR CHEMICAL AND BIOLOGICAL PROTECTION

Understanding The Effects Of Processing On Fiber/MOF Composites

Susan Kozawa U.S. Army DEVCOM Chemical Biological Center **Greg Peterson** U.S. Army DEVCOM Chemical Biological Center
Laura Mundy U.S. Army DEVCOM Chemical Biological Center

Metal-organic frameworks (MOFs) are porous solids that are capable of effectively and efficiently ab/adsorbing and detoxifying dangerous chemicals. In recent years, the manufacturing of MOFs has been successfully scaled up such that they are economically positioned to be utilized in commercial goods. While this has proved an exciting opportunity for the CBRN protective research, a challenge still exists in translating MOFs to protective gear due to their form factor as a powder. Polymer nanofibers provide for an interesting opportunity to embed these brittle materials into a viable form factor that has an inertly high surface area and tunable properties. This high surface area ensures for the maximum interface between a threat and the selected MOF, and the tunability of the fiber properties allows for the inclusion of elasticity and inherent properties of certain polymers such as a voltage response that can be utilized for sensing or energy storage. Electrospinning is a nano/microfiber production technique that uses a voltage to drive fibers out of polymer solution. This method requires a conducting and volatile solution that produces fibers at ml/hr rates. Solution blow spinning is also a nano/microfiber production technique that uses compressed air as a driving force to pull fibers out of polymer solution. This method utilizes heat, air pressure, and volatility of the solvent to produce fibers at a highly scalable level in ml/min. Here, we compared electrospinning and solution blow spinning in creating PVDF-co-HFP fibers with UiO-66-NH2. We find that even though varying processing methods produce similar fiber structures visually, they have different polymer properties and MOF loading. The crystalline structures differ due to processing method, which directly impacts attractive properties such as elasticity and energy storage. This effort highlights that processing conditions can dictate fiber morphology and reactive particle loading and describes a potentially commercially relevant route into manufacturing protective fibers.

This research is funded by DTRA project CB11222, Wendy Mills and DTRA project CB11220, Kendra McCoy.