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Reactive Materials For Personal Protective Equipment

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Engineered materials capable of capturing and removing chemical-warfare agents (CWA) and toxic industrial chemicals (TIC) are highly desirable for protective textile applications. Current personal protection garments for CWAs are either: 1) carbon-based air-permeable suits, which physically adsorb nerve and vesicant agent, or 2) impermeable protective barriers such as Teflon-based suits, which require built-in breathing units as air supply. Neither system is capable of self-detoxification of CWAs. Methods to incorporate reactive materials that can detoxify/neutralize CWAs on or into textiles have long been explored. Particularly, metal−organic framework (MOF) materials have shown remarkable ability as sorbents and catalysts for neutralizing nerve agents and TICs. MOFs are extremely porous materials composed of inorganic metal nodes connected by organic linkers to form crystalline structures. The high surface area and the ability to tailor properties for a given contaminant through de novo synthesis or post-synthetic exchange make MOFs ideal for protection against CWAs. Zirconium-based MOFs have the reported ability to catalyze the hydrolysis of organophosphates.

In a CBD SBIR funded effort, TDA has developed reactive materials and incorporated them into protective fabrics. These materials and the protective fabrics they are bound to provide broad reactivity against toxic chemical warfare agents. Both liquid and vapor hazards can be addressed with these materials. In this work, TDA has utilized hydrocolloid gelation methods to encapsulate the reactive materials. These porous polymeric materials can then be bound to surfaces and fabrics, producing a functional material that could be incorporated in protective ensembles. Production scale up techniques have been developed.

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