## MITIGATION - SCIENCE AND TECHNOLOGY ADVANCES FOR CHEMICAL AND BIOLOGICAL CONTAMINATION MITIGATION

# Tough, Permanent Self-decontaminating Paints And Coatings For Defense Applications

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Coatings are used throughout the US military and commercial sectors for corrosion protection, wear resistance, appearance, and for their ability to be cleaned/decontaminated. Materials decontamination is a critical issue for our forces and for first responders for their ability to recover from a chemical, biological, or toxic-spill incident. The use of disinfectants requires an active and constant engagement that places undue burden on personnel, the results do not persist over time, and the effluents are toxic and leach into the environment. Similarly, disinfectants are widely used in commercial, healthcare, transportation, food service, and residential settings to ensure cleanliness and to prevent the spread of infectious diseases. Self-decontaminating surface coatings are “always on”, allowing warfighter and commercial activities to continue unabated, and minimize the logistics burden of using toxic disinfectants, especially on high-touch surfaces.

Today’s Chemical Agent Resistant Coatings (CARC) provide outstanding abrasion, wear, and chemical/biological agent resistance – but can only be decontaminated using toxic, highly corrosive oxidizers such as supertropical bleach. Nanoionix has developed a breakthrough catalytic (self-regenerating) antimicrobial ceramic additive optimized for the inactivation of broad classes of viruses, bacteria, algae, chemical warfare agents, and environmental toxins without external intervention (including light, heat, or electricity). In the presence of water (ambient humidity) and oxygen (from air), this mixed-metal oxide generates spontaneously highly reactive oxygen species (ROS). ROS are known to inactivate bacteria, viruses, algae, and decompose toxic organic chemicals.

This patent-pending, low-cost, non-toxic, non-leaching/environmentally benign ceramic can be used as a standalone coating (pure ceramic) or blended with commercial paints/coatings (including CARC) to yield permanent, robust, self-decontaminating surface coatings. Coatings may be applied either during manufacture or aftermarket.

The Nanoionix team has demonstrated that self-decontaminating coatings can be deposited onto metal, polymer/plastic, ceramic, and glass substrates and impregnated into filters and fabrics – materials routinely used in military and commercial settings. The resulting composite coatings meet MILSPEC/ASTM requirements for CARC including adhesion, flexibility, impact resistance, gloss, and exposure to supertropical bleach. Samples were also robust toward solvents (representative of fuel, hydraulic fluids, and cleaners) and autoclaving (high heat/high humidity).

Composite CARC coatings showed inactivation of >99.9% of vaccinia virus (a surrogate for smallpox and monkeypox) in 5 min. Even after 10 exposures to the pathogen as well as >30% abrasion (simulating environmental wear), the performance of the Nanoionix coating did not degrade below 99% inactivation in 5 min. In preliminary tests, exposure of the coating to Bacillus atrophaeus (a simulant for anthrax) showed 95% inactivation in 5 min. (>99.9% inactivation in 120 min., meeting the US Environmental Protection Agency requirement). Nanoionix is currently testing its materials against additional pathogen/pathogen simulants and chemical challenges.

The Nanoionix self-decontaminating ceramic coating technology has been scaled to high volumes with a commercial partner and should be readily implemented across all Service needs including exterior coatings, interior paints, and fabrics as well as commercial applications such as medical equipment, hospital furniture, high-touch hardware, food service, aircraft/rail/bus interiors, air and water filtration systems, etc.

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