

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

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

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Coatings are used throughout the military for corrosion protection, wear resistance, appearance, and for their ability to be cleaned/decontaminated. Materials decontamination is critical for our forces to recover from a chemical, biological, or toxic-spill incident. The use of disinfectants requires an active and constant engagement that places an undue burden on personnel, the results do not persist over time, and the effluents are toxic and leach into the environment. Self-decontaminating surface coatings are “always on”, allowing warfighter activities to continue unabated, and minimizing the logistics burden of using toxic disinfectants. Today’s Chemical Agent Resistant Coatings (CARC) provide outstanding performance – but can only be decontaminated using toxic, highly corrosive oxidizers (supertropical bleach). With funding from DARPA, Nanoionix developed EcoCer™, a breakthrough permanent antimicrobial ceramic additive optimized for the inactivation of broad classes of pathogens, chemical warfare agents, and environmental toxins without light, heat, or electricity. In the presence of water (ambient humidity) and oxygen (from air), EcoCer™ generates spontaneously highly reactive oxygen species (ROS). ROS are known to inactivate bacteria, viruses, fungi, algae, and decompose toxic organic chemicals. This is a catalytic process: EcoCer™ is not consumed – coated surfaces are still active after abrasion, multiple exposures, and 2+ years of use. This patented, low-cost, non-toxic, non-leaching/environmentally benign ceramic can be applied as a pure ceramic layer or blended with commercial paints/coatings (including CARC) to yield permanent, durable, self-decontaminating surface coatings on metal, polymer/plastic, ceramic, and glass substrates and impregnated into filters and fabrics – materials routinely used by the military. Coatings may be applied either during manufacture or aftermarket and can be recoated or touched-up in the field. Coatings meet MILSPEC/ASTM requirements for CARC including adhesion, flexibility, impact resistance, gloss, weathering, corrosion/erosion resistance, and exposure to supertropical bleach, are robust toward solvents (representative of fuel, hydraulic fluids, and cleaners) and autoclaving (high heat/high humidity). Coatings show inactivation >99.9% for vaccinia virus (surrogate for smallpox/monkeypox) in 5 min. Exposure to E. coli and Staph aureus (MRSA) demonstrate >99% inactivation in 10 min.; exposure to B. atrophaeus (simulant for anthrax) shows 95% inactivation in 5 min. EcoCer™ also inhibits fungal and algal growth – critical for humid/wet environments and the insides of vehicles (especially naval vessels). All at room temperature. Testing EcoCer™ against additional pathogen/pathogen simulants and chemical toxins continues including the ability of EcoCer™ to react with chemical warfare agents and break them down into less hazardous materials. Initial tests by DEVCOM SC and AFCEC/CXAE on simulants for blister agents indicate reactivity – more details available from DEVCOM Nanoionix can produce ~kilogram quantities of EcoCer™ from low-cost, earth-abundant starting materials and has a manufacturing/scale-up agreement with a Fortune 200 company to produce materials at ton scale in the US. Eight potential partners/customers are testing the EcoCer™ technology for specific applications in multiple markets The EcoCer™ technology can be readily implemented across all Service needs including exterior coatings, interior paints, fabrics, medical equipment, food service, air and water filtration systems, etc. and allow warfighters to continue their missions safely and uninterrupted.

The Nanoionix team acknowledges funding from the Defense Advanced Research Projects Agency under contracts W31P4Q-21-C-0017 and W31P4Q-22-C-004 and the National Science Foundation under award 2112033 for partial support of this work.