PROTECTION - SCIENCE AND TECHNOLOGY ADVANCES FOR CHEMICAL AND BIOLOGICAL PROTECTION

Next-generation Respiratory Protective Equipment For Inactivation Of Airborne Biological Threats

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Airborne biological pathogens, naturally occurring or artificially engineered, continue to pose a major threat to society, exposing strategic vulnerabilities in global health infrastructure, supply chains, and military readiness. To address these challenges, a step-change in respiratory personal protective technology is required. XCMR is developing Next-Generation PPE that is highly effective at inactivating airborne pathogens using embedded UVC emitter technology as part of its Near-Field Infection Protection (NIP) platform.

This system utilizes UVC radiation as a primary mechanism to induce photochemical damage in microorganisms to inactivate them and provide a continuous stream of disinfected clean air to the user. UVC radiation is safely contained inside enclosed reactor pods preventing risk of human exposure and can dynamically scale to a variety of biological threats, both known and unknown.

Such a system offers significant benefits over existing available respiratory protection technology such as re-usability, adaptation to various biological threats by means of a Modular Integrated Reactor Interconnect System (MIRIS), increased service life, and lower life-cycle associated costs.

Initial prototype systems developed under U.S. DoD AFWERX STTR Phase II contract achieved a fluence rate and velocity field with uniform dose distribution and sufficiently high photon recycling to achieve > 95% inactivation of T1 phage, a surrogate virus for SARS-CoV-2, at flow rates consistent with human respiration. These data provide an indirect, but comparable performance benchmark to an N95 mask (95% filtration of 0.3-micron particles). Experimental data and advanced computer simulation techniques were used to develop numerical multi-physics models that combine optical and computation fluid dynamic (CFD) analysis. Validated computer model simulations offer a low-cost optimization digital prototyping technique enabling faster adoption and integration into multiple design configurations.

To permit interoperability with Joint Forces Powered Air Purifying Respirator (PAPR) systems, XCMR is developing compatible, filter-less, reactor pods that can be integrated into military Mission Oriented Protective Postures (MOPP) and Chemical, Biological, Radiological and Nuclear (CBRN) respirator devices such as the AVON MP-PAPR.

The Near-Field Infection Protection technology provides improved resiliency against exposure to dangerous aerosolized pathogens and is capable of being deployed across multiple operational and support roles of Joint Forces, such as expeditionary, medical, and individual service members. The development of next-generation wearable UVC powered respirator technology offers a transformative approach to modernizing biodefense efforts in the 21st century.