TECH BRIEF
(Nonconfidential)

Eltron Research & Development

Catalysts for Destruction of Chemical Warfare Agents in Air at Low Temperatures

Purpose. The objective of the Phase I program was to demonstrate the feasibility of using new heterogeneous catalysts for the oxidation/removal of chemical warfare agents (CWAs) at low temperatures in air. Such catalysts will ultimately be central to an air decontamination technology for the protection of combat personnel from CWAs. High temperature catalytic oxidation is effective for the removal of CWAs; however, minimizing the power requirements would reduce operating costs and the increase the practicality of catalytic filters for use in the field. The advantage of the technology developed during this Phase I project is that these catalysts destroy the organic portion of the CWA, while retaining the inorganic portion at low temperatures. The catalysts developed in this project combine derivatives of low temperature oxidation catalysts, recently developed by Eltron Research Inc., with high surface area oxides that preferentially form phosphates and sulfates under oxidizing conditions.

Work Performed. A series of catalysts anticipated to have high activity for the oxidation of CWAs at low temperatures were synthesized, characterized, and screened for destruction of dimethyl methyl phosphonate (DMMP) and chloroethyl ethyl sulfide (CEES). The concentrations of the simulant in the sample flow stream were approximately 1500 ppm DMMP and 5000 ppm CEES at a constant space velocity of 6000 hr^{-1}, 0.6 seconds residence time. In addition to various catalyst compositions, reaction temperature was also examined.

Results. Catalysts were studied for the removal of CWA simulants at various temperatures. The most active catalyst was found to achieve greater than 99% removal of DMMP at 250°C, for 1450 minutes, at a DMMP concentration of 1581 ppm, Ct of 1.0 $x10^7$ mg·min/m^3. Similar results were obtained with the same catalyst in air saturated with water. At ambient temperatures the same catalyst was found to have a Ct value of 4.0 $x10^6$ mg·min/m^3. With respect to the removal of CEES, the same catalyst was found to remove >95% of the CEES for more than 100 hours of operation at 350°C, CEES Ct of 1.2 $x10^8$ mg·min/m^3.

Potential Applications. The technology developed in this program will be incorporated into an air decontamination device to be used by the Department of Defense to remove CWAs. Specific applications include personal protection, air decontamination units for tents, tanks, and helicopters, and large scale units for barracks and command centers. Homeland defense applications for protection of business and homes from potential terrorist attacks will also be applicable.

In addition this technology could be used for the removal of volatile organic compounds (VOCs) resulting from solvent or fuel intensive processes. Other potential applications include use by the automotive industry for painting of automobiles, and degreasing automotive components. Chemical processing plants, and computer chip/device manufacturing where product generation requires the extensive use of solvents for procedures such as synthesis, cleaning, etching, and film deposition will also benefit from the development of this technology. Furthermore, this technology could be used on a smaller scale as a component of the ventilation system for spray-paint and degreasing booths, fume hoods, and dry cleaning.

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