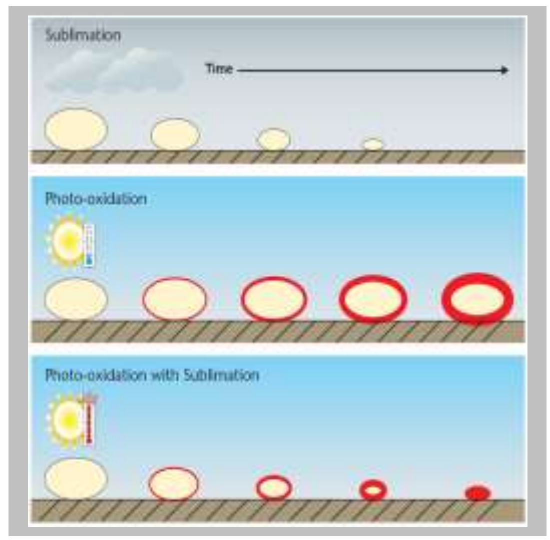
Fate Dynamics of Environmentally Exposed Explosive Traces

Roderick Kunz, Kerin Gregory, and Matthew Aernecke – MIT Lincoln Laboratory

Augustus Way Fountain III – Edgewood Chemical Biological Center



Schematic depicting the fate of a TNT particle under different environmental conditions

The chemical and physical fates of trace amounts (<50 µg) of explosives containing 2,4,6-trinitrotoluene (TNT), hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX), and pentaerythritol tetranitrate (PETN) were determined for the purpose of informing the capabilities of tactical trace explosives detection systems. From these measurements, we found that the remaining mass decreases and the chemical composition changes on a *time scale of hours*, with the loss mechanism due to a combination of sublimation and photodegradation. The rates for these processes were dependent on the explosive composition, as well as on both the ambient temperature and the size distribution of the explosive particulates.

From these results, we developed and applied a persistence model to calculate the time-dependence of both the mass and areal coverage of TNT, RDX, or PETN fingerprints at any ambient temperature. This capability will be useful for determining the impact environmental conditions will have on the tactical capabilities and limitations of non-contact and stand-off detection techniques designed to operate outdoors. In addition, we used chemical analyses to determine that sublimation rates for TNT were depressed by solar UV exposure due to photochemically-driven increases in molecular weight, whereas the opposite was observed for RDX. UV exposure did not have an effect on PETN and this observation was attributed to its low UV absorbance.

For more information, contact: Roderick Kunz, Kunz@ll.mit.edu; 781-981-7812

Reference

R. R. Kunz et al., *Fate dynamics of environmentally exposed explosive traces*, J. Phys. Chem. A 116, 3611 (2012).