OAK RIDGE NATIONAL LABORATORY FACT SHEET
MANAGED BY UT-BATTELLE FOR THE DEPARTMENT OF ENERGY

# Explosives Detection

## Boarding Pass Analyzer

### Passenger Screening for Explosives

A simple boarding pass could safeguard air travelers if an explosives detection system being developed by Oak Ridge National Laboratory and Mass Spec Analytical is adopted.

With the mass spectrometry-based instrument, a passenger's ticket would become a passive sampling device that detects even a billionth of a gram of explosives such as nitroglycerine and TNT. The instrument works by sampling air that passes over a ticket as the paper is fed through a scanner and then identifying the chemical composition of the substances in the air. The procedure takes just a few seconds and would allow all passengers to be sampled with no increase in manpower.

### Technical Concept

With the Boarding Pass Analyzer, the airline boarding pass is used to passively sample the person holding it for the presence of an explosive. The sensitivity of the system is such that even if the person were wearing protective clothing while handling the explosives, it is likely that the explosives would still be detected. The ticket comes in contact with the person's hands and clothing for in many cases a period of hours acting as an efficient passive sampling and concentrating device. Just before boarding the plane, the pass is inserted into the detector and in less than 5 seconds is analyzed for the presence of a suite of known explosive compounds (TNT, RDX, NG, etc.).

A stream of hot air thermally desorbs the semi-volatile explosive molecules from the pass into the gas-phase where they are ionized in a special ORNL-patented ion source to form negatively charged ions. There are other substances desorbed from the pass as well that are not explosives, but the majority of these are not ionized because of the selective nature of negative ionization. This limits the chemical interferences to detection from many common substances such as smoke, perfume, sweat, etc. To further limit false positive detections, two stages of mass analysis are performed with a tandem mass spectrometer. In the first stage of mass analysis, only ionized molecules with the correct mass-to-charge ratio for the targeted explosives are passed through the first mass analyzer. These ions are then broken into pieces in a collision chamber by collisions with gas molecules. The explosives at the selected masses are known to fragment to one or more "characteristic fragments" that absolutely confirm the presence of the targeted molecule.


*Boarding Pass Analyzer*

This detection system offers an advantage in speed of analysis (currently up to 1000 boarding passes/hr), sensitivity (low to sub-parts-per-billion concentration in the air, or picogram levels of explosive on the pass) and specificity (<0.2% false positive rate) compared to current explosive vapor detectors in airports today, which are based on either ion mobility spectrometry or chemical luminescence detection.



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## Development Status

This joint effort with Mass Spec Analytical of Bristol, England, takes advantage of ORNL's expertise in fundamental mass spectrometry and explosives vapor detection. Researchers have already performed many tests of the instrument, which is capable of analyzing 1,000 tickets or boarding passes per hour. One of the next steps is to incorporate a simple visual display that identifies the explosive and triggers an audible alarm. Developers also plan to add an automated calibration and threshold setting that would further prevent false alarms. Efforts are also underway to determine the best ionization source for the instrument. The ionization source is what ultimately enables the instrument to analyze the vapor and determine its identity.

The unit would sell for about $250,000 initially and would become less expensive as more units were built.

## Future Plans

In the short term, plans call for further testing of the instrument and gaining acceptance for field testing in the United States, Canada and England.

Looking ahead, the project team envisions this technology being used to protect property by tagging it with a chemical that could be detected at portals or other check points; detecting drugs, chemical and biological weapons, or detecting pesticide residue on food; medical diagnostics such as analyzing breath for drugs or for determining the presence or states of disease; or in law enforcement for non-invasive and immediate forensic analysis of traces of gunpowder residue, explosives, drugs and traces of other illicit activity such as chemical vapors from drug labs.

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