

Theft Prevention

Encapsulated Chemical Taggants

The prevention of theft and espionage is a problem that has always been important; however, it becomes crucial when significant financial losses occur or when the need to maintain technological advantages is critical. Methods for preventing theft are of great interest to government facilities, military facilities, industrial facilities, commercial business, and to research facilities interested in protecting objects containing intellectual property. Technology at ORNL has been developed for using materials with unique chemical signatures embedded in coatings or solid materials combined with sensitive chemical detectors to detect the unauthorized removal of any object.

Technical Concept

The approach involves applying microcapsules of a chemically inert taggant material to high-value items (Figure 1). These microcapsules contain small quantities of non-naturally occurring substances with unique chemical signatures. When the tagged items are handled, the capsules rupture and release small amounts of taggant vapor. Vapors of the chemical tag can be detected by chemical detectors or point monitors placed near where items are located, in entry or exit ways to rooms, buildings, or stores. The taggant coating system has been designed such that incidental handling of tagged items does not result in an alarm unless the tagged item itself is carried past the monitoring point. This limits false detections. Stationary point monitors can be located anywhere there is the need for continuous, remote monitoring. A taggant coating system has been developed which utilizes an inert fluorinated chemical taggant encapsulated in a polymer microcapsule. A polymer binder attaches the microcapsules of taggant to the item of concern. The polymer binder-chemical taggant compound can be sprayed or brushed on items in which theft or loss would be detrimental.

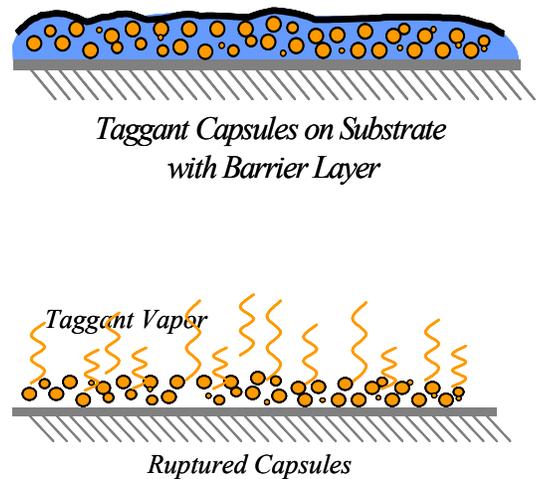


Figure 1. Taggant Concept

A personnel portal and mass spectrometer interface has been developed to detect the objects containing the chemical tags (Figure 2).

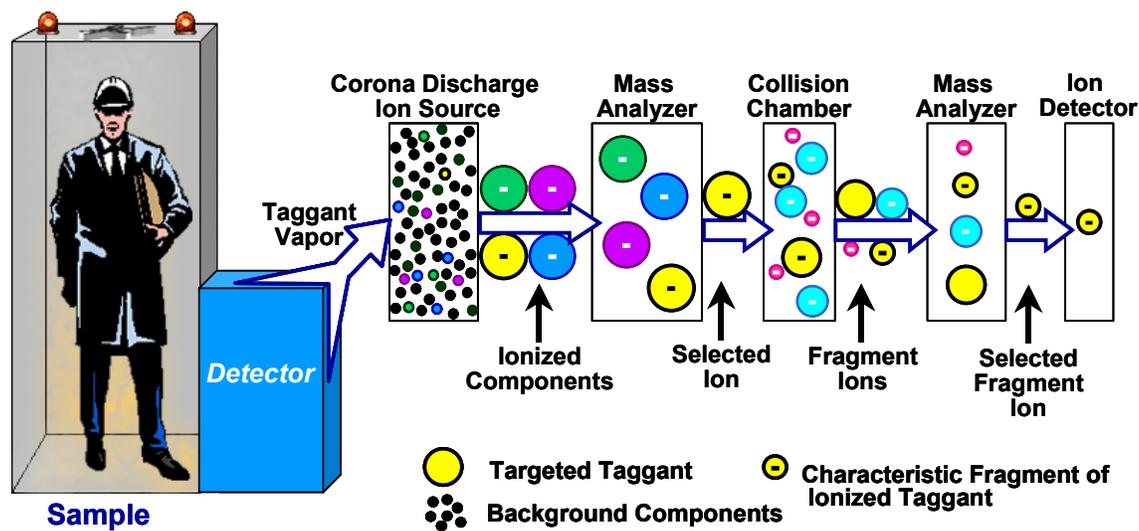


Figure 2. Detection Scheme

A personnel portal and mass spectrometer interface has been developed to detect the objects containing the chemical tags. Air in the portal is sampled, heated, and transferred to the ionizing chamber of the tandem mass spectrometer. Monitoring of the portal occurs simultaneously and without the delays associated with preconcentration systems. The mass spectrometer can detect part-per-trillion concentrations of the taggant vapor. The mass spectrometer also has a very high selectivity or ability to easily tell the difference between similar compounds. This is because two stages of mass analysis occur. In the first stage of mass analysis, only ionized molecules with the correct mass to charge ratio for the taggant material are allowed to pass through the first mass analyzer. These ions are then fragmented into pieces in a collision chamber by collisions with gas molecules. The taggant materials are known to fragment into one or more characteristic fragments that indicate the structure of the material, and absolutely confirm the presence of the taggant molecule. These features allow very small quantities of material to be used in coatings and decrease the likelihood of false positives or false negatives.

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