16.9: Green Chemistry for Sustainable Prosperity and a Safer World

A key to protection from terrorist threats is their detection before damage can be done. The detection of explosives immediately comes to mind. Another priority area is detection of disease-causing pathogenic organisms.

Hazardous substances are not readily detected by standard metal detectors and X-ray imagers used to find weapons and bombs on air travelers and in their luggage. Residues of TNT, RDX, and PETN explosives (see Figure 16.1) can be detected by sophisticated instruments including ion mobility spectrometers and chemiluminescence sensors. Such instruments normally detect residues of explosives on swabs from swabbing luggage; they can be circumvented by careful cleaning of luggage. Nuclear quadrupole resonance (NQR) may develop as an especially promising detection technique for explosives. One reason for this is its specificity for nitrogen, which is abundantly present in all common explosives. Secondly, NQR has the potential to detect explosives in containers and even land mines. It works by generating a pulse of radio frequency radiation which excites nitrogen atoms to higher quantized energy levels. By following the signals given off as the atoms return to their ground energy levels the kinds and abundances of nitrogen functional groups in explosives molecules can be determined.

“Canine olfactory detection,” which uses the sniffing abilities of dogs, is widely used to detect explosives, illicit drugs, and other potentially hazardous materials. A dog has approximately 220 million mucus-coated olfactory receptors, about 40 times the number possessed by a human, making the canine nose an extraordinarily sensitive detector. In order for canine olfactory detection to work, a rewards system must be used. This can lead to unpredictable, temperamental behavior in dogs of the type commonly attributed to humans and computers. As a result, dogs are not completely reliable and, according to an authority on the subject, “Dogs lie. We know they do.”[5]