The Economist

Detecting explosives

The litmus test

A new way to spot home-made bombs

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ALTHOUGH surveillance has increased around the world following March 22nd's bombings in Brussels, it remains extremely difficult to detect explosives carried into railway stations, shopping malls and other public places. The bombs used in Belgium might well have been picked up after the check-in desks at Zaventem Airport, but the suicide-attackers probably never intended to reach the security gate. The intensive screening carried out inside airports is not practical in many other places. That could change as new techniques are developed.

The bombs in Brussels were composed of triacetone triperoxide, known as TATP. This is the same explosive used to kill 52 people in London in train and bus attacks in 2005. It is extremely unstable, but for terrorists bent on sacrificing themselves TATP has considerable appeal since it can be made from compounds found in easily obtained materials such as paint thinners and hair-bleaching agents.

TATP can be detected with traditional technologies, like ion mobility spectrometry. This uses a desktop machine to analyse swabs. As the process can pick up minute traces of substances associated with explosives, it is hard to prevent at least a few molecules escaping onto someone's hands and belongings. But even in airports, not every passenger is swabbed. Some machines sample air puffed onto passengers standing in cubicles, but it is a slow process. Dogs can pick out TATP, but handlers had been reluctant to train their animals to find the explosive because even tiny amounts can detonate. Now, though, trainers can use TATP as beads encased in a polymer that prevents detonation but also releases the odour.

Such developments help, but airport-style security would be expensive and highly disruptive if these measures were imposed at all the entry points to crowded public places. Far better would be a system that can automatically analyse air samples and raise an alarm if any dangerous compounds are detected. That idea had seemed fanciful, but Kenneth Suslick at the University of Illinois at Urbana-Champaign thinks he has found a way to do it.

Dr Suslick's strategy is to hunt for TATP using chemical dyes which can readily bind to reactive airborne compounds, changing colour when they do so. By using differently coloured dyes that each have an affinity for molecules of a specific compound released into the air by different explosives, the system would generate a unique colour signature when a dangerous material was nearby. Dr Suslick thinks that adding sensors onto a small cartridge-type device containing an array of different dyes would improve the system further by measuring other characteristics of airborne particles, such as their acidity and molecular polarity (the way they conduct a charge). It appears to be a complex bit of kit, but Dr Suslick is quick to point out that the method is really not much different to a multidimensional form of litmus paper.

After collaborating with colleagues for more than a decade, Dr Suslick has successfully designed a set of dyes that can detect many of the explosive compounds terrorists are likely to wield, including TATP. In a study last year they found that ferrous chloride reacted vigorously with airborne hydrogen peroxide that travelled out of a small sample of TATP and that this exposure oxidised the ferrous chloride, turning it from blue-green to yellow-brown. The researchers have also reported that a device, similar to the sort traditionally used to scan information on business cards, was able to monitor the many different colours on their dye array and signal if it had detected compounds in the air indicative of dangerous materials nearby.

Given that the researchers reckon each array at the centre of the device could cost less than a dollar to make, the technology appears to have the potential to be used in hand-held devices that could be widely carried by security staff. They could stand by the entrances to malls, airports and stations, checking people as they walk past with little disruption (although terrorists could still detonate their device among the crowds milling outside the building). Plans are afoot to commercialise the technology.

The idea, if successful, could be developed further. If the detectors were positioned around a building they might be connected by a wireless network to automatically track the chemistry of the air. The main challenge is that the arrays are like chemical fuses and must be changed after being tripped. Dr Suslick, however, thinks one way around that is to use cartridges that have multiple arrays stored on a spool, so that a new one becomes available as soon as a used one gets soiled. The trick with security is to try and remain one step ahead of the terrorists. If this idea succeeds, it might be a leap.

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