Development of analytical instruments to detect explosives

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The recent terror plot to transport printers containing the explosive pentaerythritol tetranitrate, or PETN, from Yemen to Chicago synagogues has once again focused attention on the need to detect explosives reliably and in real-time. PETN is the same explosive that the so-called 'shoe-bomber' tried to set off on an American Airlines jet to Miami in 2001. More recently PETN was involved in the failed attempt to set off a bomb on an airliner in midair (Northwest Airlines Flight 253, 25 December 2009) by Nigerian-born Umar Farouk Abdulmutallab, and in the attempted assassination of a member of the Saudi royal family this summer.

PETN is an extremely powerful explosive, belonging to the nitroglycerine family, but is very stable. It is therefore a preferred explosive used by terrorists. A major problem for security personnel is that PETN is difficult to detect. In collaboration with researchers at the Universities of Innsbruck and New York, and an Innsbruck-based spin-out company, Ionicon Analytik GmbH, Dr Chris Mayhew of the University of Birmingham's School of Physics and Astronomy, has been investigating the potential of a relatively new analytical technique – Proton Transfer Reaction Mass Spectrometry (PTR-MS) – for the detection of explosives. This collaborative project has demonstrated the capabilities of using PTR-MS for the detection of trace quantities of PETN.

Crucially, the identification of explosives, such as PETN, with a high level of confidence in real-time and in trace quantities is of great importance to the military, to emergency responders, and for applications in checkpoint security areas such as airports, harbours and train stations. On the basis of our proof-of-principle studies, the Home Office has provided funding to the University of Birmingham with the objective to develop, in collaboration with Ionicon Analytik GmbH (the world leading manufacturers of PTR-MS instruments), PTR-MS technology for use in security areas.

Other Birmingham researchers have been leading a large European Commission funded project dealing with the ethical and human rights risks of the use of detection technologies in counter-terrorism. Counter-terrorism is riddled with uses of detection technology directed at people, and these carry many risks—invasion of privacy, error leading to wrongful detention, apparent and real discrimination against 'suspect' minorities. None of these problems are raised by technologies for the detection of dangerous substances, especially where these are deployed in freight containers and warehouses, or in screening of baggage at airports. In the case of PETN, which is very difficult to detect by pat-down searches or body scanning in any case, the use of PTR-MS instruments is a very promising approach.

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