EMRP Call 2011 - Health, SI Broader Scope & New Technologies

Selected Research Topic number: **SRT-n16**
Version: 1.0

Title: Chemical metrology for the accurate identification and detection of hazardous and hidden materials

Abstract

New technologies are required to give rapid, specific and dependable detection of hazardous materials such as explosives in challenging environments for border control, emergency response and cargo screening. A robust underpinning metrology framework is required since decisions based on these measurements can be extremely costly and/or life threatening. Major requirements are for trace detection of explosives (< nanogram) on surfaces such as clothing, packaging and skin as well as remote and high-throughput detection of concealed explosives in cargo, luggage and mail. Similar requirements exist for on-site monitoring of toxic fumigants used for pest control in cargo containers.

Conformity with the Work Programme

This Call for JRPs conforms to the EMRP Outline 2008, section on “Grand Challenges” related to Health, New Technologies & Fundamental Metrology on page 25.

Keywords

Forensic, explosive detection, hazardous material, ambient mass spectrometry, reference materials, improvised explosive devices, concealed explosive, fumigants, cargo

Background to the Metrological Challenges

The European Security Research and Innovation Forum (ESRIF) Final Report [1], published in December 2009, highlights the need for development of fast and reliable detection and control systems concerning explosives at vulnerable locations, buildings and events, development of fast analysis techniques for a whole spectrum of explosives, to allow an adequate response to suspicious incidents.

Present on site testing technologies/methods such as ion mobility spectrometry and chemical and antibody based dipstick methods have significant levels of false negatives and false positives and require confirmatory methods. For credible forensic evidence, materials need to be collected, extracted/digested and taken to a specialist laboratory for analysis. Some of the methods currently used are:

- Ion mobility spectrometry (IMS): used to detect explosives under a range of sampling conditions
- Ambient surface mass spectrometry: provides high sensitivity mass spectrometry directly from surfaces at ambient pressure
- Cavity ring down spectroscopy (CRDS): a sensitive optical method, which may be used for the detection of trace levels of explosives
- Terahertz (THz) spectroscopy and imaging: the ability to detect hidden explosives since the electromagnetic waves penetrate packing materials such as paper, plastic, glass and clothing.

Special metrology facilities with a controlled environment for the development of refined sensor technologies have also been developed in Europe. Only recently, NIST has started to produce reference materials for this field of application [e.g., SRM 2905, Trace Particulate Explosives]. No European NMI provides such reference materials yet.

The United Nations Food and Agricultural, Organization in order to prevent the spread of pests, has stipulated mandatory fumigation or heat treatment of cargo containers; however, heat treatment is rarely available at ports making the fumigation with toxic chemicals the common approach.

EURAMET, EMRP-MSU
National Physical Laboratory
Hampton Road, Teddington,
Middlesex, TW11 0LW, UK

Phone: +44 20 8943 6666
emrpA169@npl.co.uk
www.euramet.org

EMRP
European Metrology Research Programme
Programme of EURAMET

The EMRP is jointly funded by the EMRP participating countries within EURAMET and the European Union

For the cargo containers, national and international exposure limits have been set to protect individuals (MAC – maximum workplace concentration; CEL – community exposure level; OEL – occupational exposure limit, etc), but in order for the limits to be of any use, reliable and practical methods to monitor the working environment is needed.

A number of techniques can be used for air monitoring. Indicator tubes based on chemical colour change are simple to handle and light weight and they can be found for a broad array of substances; however, the long term costs are significant (50 euros per sample) and they have been shown to be unreliable for several species, in particular for methyl bromide monitoring. The development of new transportable, specific, sensitive and cost effective devices is urgently needed.

Scientific and Technological Objectives

Proposers should address the objectives stated below, which are based on the PRT submissions. Proposers may identify amendments to the objectives or choose to address a subset of them in order to maximise the overall impact, or address budgetary or scientific / technical constraints, but the reasons for this should be clearly stated in the JRP-Protocol.

The JRP shall focus on traceable chemical measurements to support systems for the detection of hazardous and hidden materials in challenging environments for border control, emergency response and cargo screening.

The specific objectives are:

1. To develop reference materials for single and multi-component explosives in the gas phase and at surfaces
2. To develop quantitative methods with a sensitivity less than a nanogram for trace detection of explosives on surfaces.
3. To develop remote monitoring methods suitable for detection of explosives concealed in cargo, luggage, mail and clothing.
4. To develop measurement technologies for on-site monitoring of toxic fumigants used for pest control in cargo containers.

The materials under consideration should be selected and prioritised according to declared stakeholder needs.

These objectives will require large-scale approaches that are beyond the capabilities of single National Metrology Institutes and Designated Institutes. To enhance the impact of the research, the involvement of the appropriate user community such as industry, and standardisation and regulatory bodies, is strongly recommended.

Proposers should establish the current state of the art, and explain how their proposed project goes beyond this.

The total eligible cost of any proposal received for this SRT is expected to be around the 2.7 M€ guideline for proposals in this call.

Potential Impact

Proposals must demonstrate adequate and appropriate participation/links to the “end user” community. This may be through the inclusion of unfunded JRP partners or collaborators, or by including links to industrial/policy advisory committees, standards committees or other bodies. Evidence of support from the “end user” community (eg letters of support) is encouraged.

You should detail other impacts of your proposed JRP as detailed in the document “Guide 4: Writing a Joint Research Project”

You should detail how your JRP results are going to:

- feed into the development of urgent documentary standards through appropriate standards bodies
- transfer knowledge to the security and trade sector.

You should also detail how your approach to realising the objectives will further the aim of the EMRP to develop a coherent approach at the European level in the field of metrology. Specifically the opportunities for:

- improvement of the efficiency of use of available resources to better meet metrological needs and to assure the traceability of national standards
- the metrology capacity of Member States and countries associated with the Seventh Framework Programme whose metrology programmes are at an early stage of development to be increased
- outside researchers & research organisations other than NMIs and DIs to be involved in the work

Time-scale

The project should be of up to 3 years duration.

Additional information

The references were provided by PRT submitters; proposers should therefore establish the relevance of any references.

[1] http://ec.europa.eu/enterprise/policies/security/files/esrif_final_report_en.pdf