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

Selected Research Topic number: **SRT-n05**
Version: 1.0

Title: Metrology for Raman spectroscopy

Abstract

Raman spectroscopy is a light scattering phenomenon where the scattered light carries a fingerprint of the chemistry and structure of the substance under test. It is critical for measurements for biotechnologies and nanotechnologies, but currently the data collected is not traceable. Metrology is urgently required for far-field, near-field and multi-photon Raman techniques to make them quantifiable and traceable to the mole. The proposed JRP shall investigate the metrology related to light-matter interactions, spatial and depth resolutions, and sample volume.

Traceable Raman spectroscopy has the potential to support a wide variety of industrial sectors including; medical, pharmaceutical & healthcare, food & agriculture, forensics, chemical, materials (particularly nano and biotechnology) and the Raman Spectrometer Manufacturers

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 pages 9,22 and 25.

Keywords

Raman spectroscopy, far-field, near-field, multi-photon, spatial resolution, enhancement factor, scattering cross section

Background to the Metrological Challenges

Raman spectroscopy is a non-contact emission technique that provides chemical and structural information about a gas, liquid or solid under test. Due to the non-contact methods it is particularly useful for delicate nanostructured devices and surfaces. However Raman Spectroscopy cannot currently offer traceable measurements, and suffers from poor repeatability which means it is only used as a qualitative tool.

Currently no documentary standards exist for Raman Spectroscopy techniques, or the development of reference materials. NIST have developed relative intensity correction standards for Raman Spectroscopy, but there are no absolute standards available. ASTM are currently seeking participants for the development of a proposed new standard, WK18814, “Guide for Relative Intensity Correction of Raman Spectrometers”, being led by their sub-committee on Raman Spectroscopy (E13.08)

There are also needs for traceability regarding the spatial resolution and depth of various Raman techniques, and for in-vivo measurement of samples.

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 should provide reliable quantification and traceability with low uncertainties for various Raman spectroscopy techniques for application in chemical measurements. It should study far-field, near-field and multi-photon Raman spectroscopy.

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The specific objectives are:

1. In far-field Raman spectroscopy to;
   - Achieve quantification and traceability for chemical measurements through comprehensive understanding of light matter interactions
   - Significantly improve spatial resolution (below 1 µm) and sensitivity of detection
   - Develop procedures and reference samples.
2. In near-field Raman spectroscopy to;
   - significantly improve repeatability, detection sensitivity and spatial resolution.
3. In multi-photon Raman spectroscopy to;
   - achieve significantly increased accuracy and traceable measurements of chemical quantities and improve the detection limit.

The JRP should identify and prioritise key application areas, based on documented stakeholder needs, where the improved quantification and traceability result in significant impact for society and/or industry.

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,
  - ASTM sub-committee on Raman Spectroscopy (E13.08); proposed new standard, WK18814, “Guide for Relative Intensity Correction of Raman Spectrometers”
  - CEN
- transfer knowledge to the pharmaceutical, healthcare, forensic, food, agriculture, chemical, materials, and medical sectors
- Transfer knowledge to the nanotechnology and biotechnology industries
- Transfer knowledge the Raman Spectrometer Manufacturers

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.