EMRP Call 2012 – Open Excellence, Industry and SI Broader Scope

Selected Research Topic number: **SRT-i03**
Version: 1.0

Title: Metrology for long lifetime flexible large area electronics

Abstract

Flexible large area electronics is an emerging technology with potential applications ranging from renewable energy generation to ultra-efficient large area lighting and smart packaging. One major hurdle delaying large scale adoption of this new technology is insufficient lifetime of the new materials and devices. There is an urgent requirement to develop and apply advanced metrology to investigate the stability of devices, to create hypotheses for specific degradation mechanisms and form recommendations for accelerated aging test protocols.

Conformity with the Work Programme

This Call for JRPs conforms to the EMRP Outline 2008, section on “Grand Challenges” related to Industry & Fundamental Metrology on pages 8, 9, 11 and 14.

Keywords

Organic electronics, plastic electronics, stable, lifetime, materials properties, efficiency, luminance, degradation, organic semiconductor, organic conductor, light emitting diode, photovoltaic solar cell.

Background to the Metrological Challenges

Current estimates for organic device lifetime range from around 5 years for OLEDs to only 1year for OPVs. These values are based on non-standardised test conditions. Such stability levels have been achieved by a number of developers in Europe and the Far East, with access to significant capability in the synthesis of new materials.

Improvements in device stability are currently mainly achieved by an empirical approach, combining alterations of layer materials and thicknesses, along with modifications to organic semiconductor material functional groups and the synthesis process. There is a lack of research into the specific degradation mechanisms and no specific metrology available which is tailored to this purpose. For example, optical methods, such as Raman, can probe material chemistry, but spatial resolution is limited (~µm) and sensitivity may be insufficient. Furthermore, atmospheric exposure of samples and devices is common in current degradation research, which casts significant doubt over the validity and usefulness of the resulting data.

For initial performance measurements on OPVs, standards based on inorganic devices are used, however globally validated sites for solar cell measurement (of any type) are few. Protocols used for OLED device and electronic display tests are based on assumptions relevant to inorganic devices and to liquid crystal displays. Many of these assumptions are not valid for LEDs incorporating organic semiconductor materials.

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 metrological methods to investigate the stability of new organic semiconductor materials (small molecules and polymers) and plastic electronic devices, to create hypotheses for specific degradation mechanisms, and to propose recommendations for accelerated aging test protocols.

The specific objectives are:

1. Characterisation of material, device and system modes of performance decay (via time-dependent device efficiency and electrical property measurement).
2. Determination of specific material and device degradation mechanisms (via optical, chemical, morphological and mechanical property measurement).
3. Development of theoretical models for predicting material stability and device lifetime based on hypotheses for specific degradation mechanisms.
4. Development of accelerated and field aging tests for materials, devices and systems, with recommendations for lifetime test protocols.
5. Development of traceable and accurate methods for measurement of the efficiency of organic solar cells and modules (initial OPV performance metrology).
6. Development of traceable and accurate methods for measurement of the luminance and spectral characteristics of organic light emitting diodes and electronic displays (initial OLED performance metrology).

Proposers shall give priority to work that meets documented industrial needs and include measures to support transfer into industry by cooperation and by standardisation. An active involvement of industrial stakeholders is expected in order to align the project with their needs.

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. The available budget for integral Research Excellence Grants is 42 months of effort.

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 (e.g. letters of support) is encouraged.

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 electronics sector

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

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 and includes the best available contributions from across the metrology community. 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.