European Metrology Research Programme

Delivering Impact

High-performance self-heating materials

PTC thermistors are an important component in many electronic products, such as lithium-ion batteries, due to their ability to limit current and regulate temperature. However, these functions rely on the incorporation of well-characterised self-heating materials in their design. Improvements to the metrology underpinning the characterisation of these materials will help the electronics industry manufacture existing products more efficiently and support the development of new products with improved performance.

Europe's National Measurement Institutes working together

The European Metrology Research Programme (EMRP) brings together National Measurement Institutes in 23 countries to address key measurement challenges at a European level. It supports collaborative research to ensure that measurement science meets the future needs of industry and wider society.

Challenge

Positive temperature coefficient of resistivity (PTCR) ceramics are a type of material which becomes highly resistive when heated beyond a threshold temperature. This behaviour makes PTCR ceramics ideal for use as thermistors in electronic devices and in the heating elements of consumer products such as car window demisters and space heaters.

More accurate measurements of the self-heating and current-limiting effects generated in PTCR ceramics are needed to enable the design of components for improved electronics and more effective process control during manufacturing. However, until recently, industry did not have access to the capabilities it needs to make traceable measurements of these properties.

Solution

The EMRP project *Electromagnetic characterisation of materials for industrial applications up to microwave frequencies* developed a traceable calibration system for PTCR ceramics, which provides fast, non-destructive characterization of samples, reducing design and production costs. Research carried out by the project has contributed greatly to the quantification and improvement of uncertainties involved in these measurements, supporting the efficient development of materials for the electronics industry.

Impact

The measurement test cells developed are now being used by the Jožef Stefan Institute (IJS) in Slovenia. IJS develops prototype PTCR ceramic materials for use in electronic devices and was looking to reduce its R&D costs through an automated, traceable and reliable measurement system for characterising samples of PTCR ceramics.

New measurement test cells were constructed, tested and validated within the project, and the complete system automated for use in IJS's materials development facility, enabling it to make measurements of samples directly after they have been produced. This system can now be used for quality control during manufacture or for gathering information on newly-developed materials for IJS's customers in the electronics industry.

One such customer, STELEM is a major European producer of thermistors for applications such as home appliances and vehicles. They are using the research facilities at IJS to provide traceable characterisation of their components assuring their performance.

This is just one early example of how the results of this EMRP project are supporting manufacturers to develop improved products for the electronics industry.

Metrology for advanced electronics materials

To develop faster electronics and effective microwave communication systems, developers need to understand the electromagnetic performance of materials at radio and microwave frequencies. The EMRP project *Electromagnetic characterisation of materials for industrial applications up to microwave frequencies* developed a range of tools for the accurate measurement of key electromagnetic properties, which provide valuable information on the capacitance, conductivity and permittivity of materials. These tools will support the electronics industry to improve the performance of existing materials and enable the uptake of new materials needed for ultrafast applications.

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