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Research Programme
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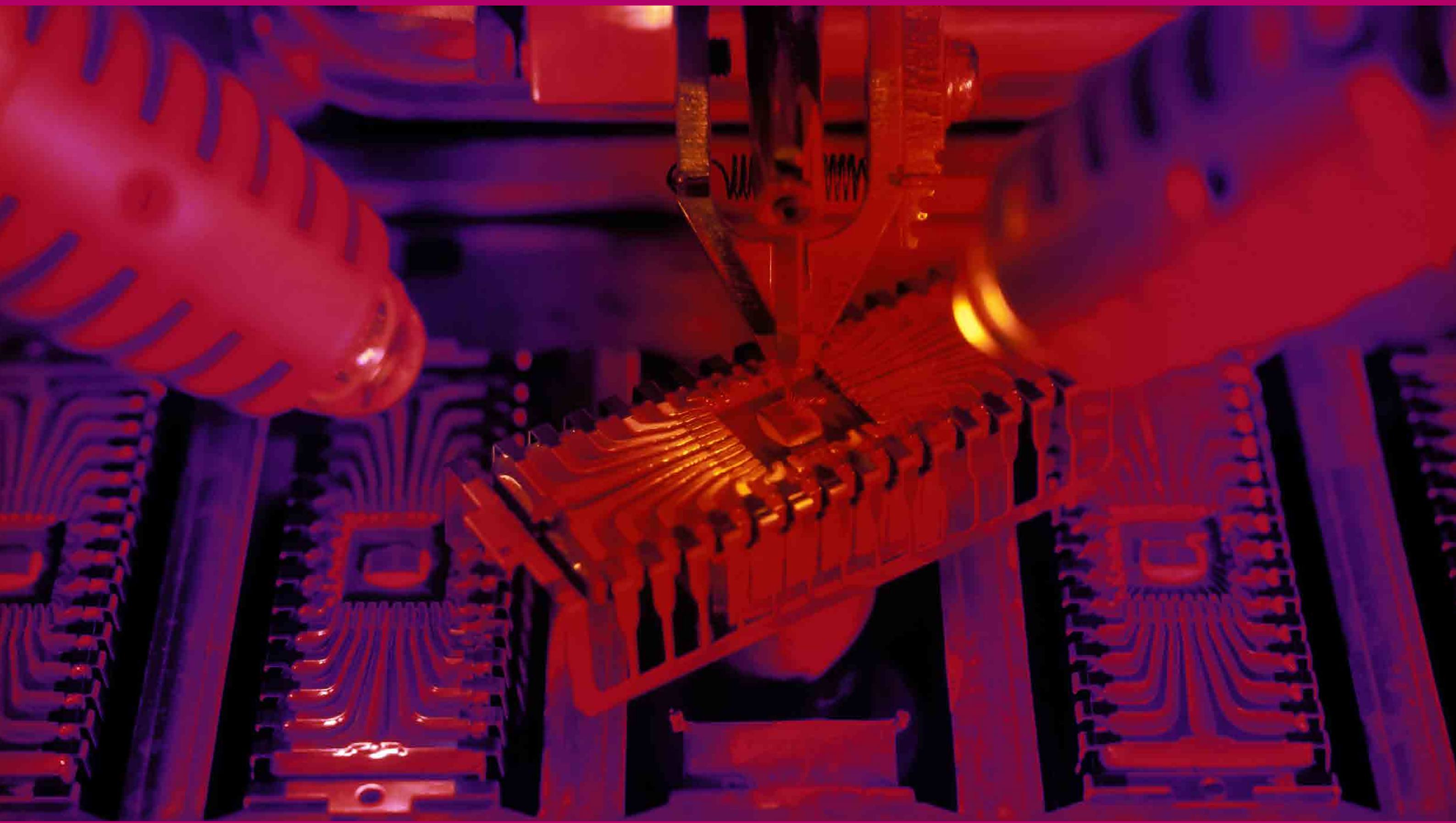


# Piezoelectric innovation

Piezoelectric materials– which turn movement into electricity and vice versa – need to be able to operate at high temperatures to make new products possible such as sensors for engine testing. Incorporating new high temperature piezoelectric materials into innovative product designs relies on accurate material data underpinned by reliable methods. Developing test methods for these materials and demonstrating their accuracy is essential for increasing uptake of advanced materials into new technologies.

**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

Piezoelectric materials, which convert movement into electrical signals and vice versa, are used in a wide range of applications such as gyro-sensors, and micro switches in miniaturised electronic devices. In addition, their unique characteristics make them suitable for sensing operations where continuous remote monitoring of real time systems is needed.

Many of these sensing applications require devices to perform in high temperature environments, where established piezoelectric materials lose performance. However, innovative new piezoelectric materials could offer greater precision and sustained functionality at high temperatures, but these need to be well understood before they can be used in commercial products.

For designers to confidently incorporate new piezoelectric materials into high temperature sensors they must have confidence in the devices ability to perform to specification. Accurate and robust test methods are needed to provide the rigorous piezoelectric test data that forms the basis for reliable sensor specifications.

# Solution

The EMRP Project *Metrology of electrothermal coupling for new functional materials technology*, evaluated different compositions of piezoelectric materials with the aim of developing high temperature piezoelectric reference materials. One of the compositions, supplied by Leeds University, was optimised, and characterised at temperatures up to 380 °C without losing performance. This demonstrated its viability as a reference grade material suitable for use in developing new test methods and for validating the ongoing performance of material testing instruments and enables testing to higher temperatures than previously possible.

# Impact

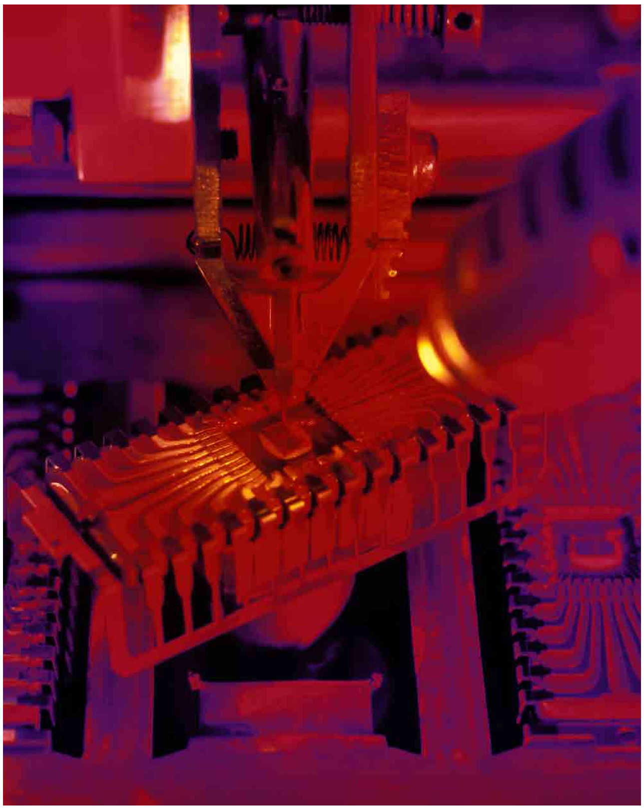
AixACCT Systems GmbH, a leading manufacturer of instruments for testing the electrical properties of materials, has improved its aixPES Piezoelectric Evaluation system as a result of using the new piezoelectric reference materials. The aixPES system's ability to measure piezo-materials across a wider temperature range was improved and AixACCT Systems now have an easy way to determine that their machines are correctly set up and measuring accurately.

The resulting accuracy improvements, and demonstration of performance at higher temperatures than previously possible, gives greater confidence in piezoelectric materials testing using the aixPES system. AixACCT's customers – testing materials for applications such as gyro-sensors, microphones and miniature speakers – will now have more reliable data to use for material specifications.

Greater certainty in how piezoelectric materials behave and increased confidence in their performance at elevated temperatures will enable product designers to confidently create new devices. Ultimately, this will enable increased uptake of piezoelectric materials into advanced devices and sensors, bringing new and improved functionality to these innovative high-tech applications.

## Traceable characterisation for novel materials

Piezoelectric materials have potential applications as high temperature sensors in industrial processes whilst electro-caloric material could be used for magnetic refrigeration, so reducing reliance on propellant gas cooling in industry. The EMRP project *Metrology of electrothermal coupling for new functional materials technology* developed methods to improve thermal, mechanical and electrical property traceability for these materials at high temperatures (up to 1000 °C) or in strong electric fields (up to 5 kV/mm). Understanding how these materials will perform once installed into processes based on traceable material characterisation is a pre-requisite for the development of next generation products such as fuel flow in aero-engines or solid state cooling in the electronics industry.





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