EURAMET

European Association of National Metrology Institutes

European Metrology Research Programme

Industrial Innovation

An overview of the funded projects from the Targeted Programme Industry.

The aim of these projects is to help develop measurement methods and techniques to improve traceability for industrial processes.

The projects focus on enhancing existing technologies, as well as creating innovations and step changes within new technologies.

Improving the efficiency of industrial processes

Reducing energy use through accurate temperature measurement

Temperature measurements above 1000 °C are difficult to make but necessary for many industries such as aerospace and steel production.

As industries cannot accurately measure these high temperatures, they often run processes too hot and therefore operate inefficiently. By developing a range of measurement methods, accurate at high temperatures, this project will enable more efficient operation of industrial processes, reduced energy use and lower greenhouse gas emissions.

The project will focus on both 'in situ' techniques, where measurement devices are located directly in the environment being measured, as well as non-contact techniques that can take measurements without directly exposing devices to the high temperatures involved.

Project IND01: High temperature metrology for industrial applications

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projects.npl.co.uk/hitems

Advancing the European electronics industry

Measuring high-speed electronics

To cope with the increasingly high operational speeds of modern electronic equipment, new measurement techniques are required to assess the electromagnetic materials used in the fastest applications – at microwave frequencies up to 80 GHz.

The improved techniques produced by this project will support innovation in the European electronics industry by enabling reliable measurements at nano, micro and macro scales and less resource-intensive production processes.

This will help new electronic devices to be made smaller and more powerful, and will contribute to the development of technologies such as piezoelectrics, ferroelectrics, thin films, graphene and higher frequency medical ultrasound imaging.

Project IND02: Electromagnetic characterisation of materials for industrial applications up to microwave frequencies

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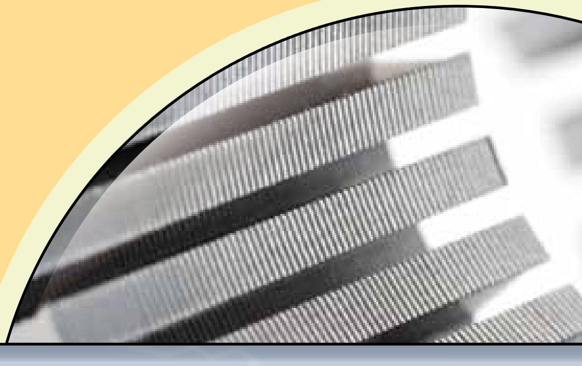

Europe's National Measurement Institutes working together

The majority of European countries have a National Measurement Institute (NMI) that ensures national measurement standards are consistent and comparable to international standards. They also investigate new and improved ways to measure, in response to the changing demands of the world. It makes sense for these NMIs to collaborate with one another, and the European Association of National Metrology Institutes (EURAMET) is the body that coordinates collaborative activities in Europe.

EURAMET has implemented the European Metrology Research Programme (EMRP), a project programme organised by 22 NMIs and supported by the European Union, which will have a value of over 400 M€. The EMRP facilitates the formation of joint research projects between different NMIs and other organisations, including businesses, industry and universities. This accelerates innovation in areas where shared resources and decision-making processes are desirable because of economic factors and the distribution of expertise across countries or industrial sectors.

EURAMET wants to involve European industry and universities at all stages of the programme, from proposing Potential Research Topics to hosting researchers funded by grants to accelerate the adoption of the outputs of the projects.

Full details can be found at: **www.euramet.org**

Enabling higher pressure industrial processes

High-pressure measurements for industry

Advanced high-pressure technologies are frequently used in the petrochemical, pharmaceutical and car industries. In the car industry the application of high, continuously increasing, pressures plays a vital role in the manufacturing of direct injection fuel systems, which have improved petrol and diesel engine performance.

The pressures used in some modern systems are higher than the current European calibration capability, which is limited to around 1 GPa. This project aims to develop new standards to extend this capability to 1.6 GPa and to support the continuing use of high-pressure technologies.

This will enable an increase in product quality and lifetime, a saving of materials and a reduction in energy use and pollution.

Project IND03: High pressure metrology for industrial applications

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Removing radioactive waste from recycled scrap metals

Preventing the spread of radiation in European steel

Millions of tonnes of scrap steel are produced each year that could potentially be contaminated by radioactive sources, for example demolition material from hospital radiotherapy facilities hidden in scrap metal loads.

The accidental contamination of scrap metal loads can result in the subsequent contamination of furnaces, metal by-products and the environment, leading to human health risks and international trade disputes.

Current radioactivity testing involves passing scrap metal loads under radiation detector panels, but this approach is not always effective. This project will produce new reference materials, methods and devices to improve the detection of radioactivity in scrap loads and will reduce the risk of irradiation across Europe.

Project IND04: Ionising radiation metrology for the metallurgical industry

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Widening the use of polymers in industry

Improving confidence in polymer properties

Polymers (e.g. plastics and rubber) are often used to reduce the cost and weight of manufactured goods. However, they are viscous and so can deform under stress and over time. This is not ideal for industrial applications, in particular in car manufacturing or water pipes, where materials need to remain stable and predictable over many years.

This project will develop methods for measuring viscous materials, including measurements of shape, mechanical properties and deformation rate.

The project will also help widen the use of recycled polymer materials as current uptake is limited because of the higher uncertainty and variability in their properties, compared with virgin materials.

Project IND05: Dynamic mechanical properties and long-term deformation behaviour of viscous materials

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Improving data security with quantum technologies

Guaranteeing the security of sensitive data

An ever-increasing amount of sensitive information such as bank details is stored, transferred and accessed over computer networks. Quantum communication technologies such as Quantum Key Distribution (QKD) can improve the security of this data.

The unique feature of QKD is that, when implemented correctly, the system guarantees that the encryption key has not been intercepted. It works by transmitting information in a photon in a particular 'quantum state' and then detecting if an intruder has disturbed that state. In theory it is extremely effective but there are no agreed methods to demonstrate that practical implementations are robust.

This project will develop new measurement techniques to validate the practical use of QKD.

Project IND06: Metrology for industrial quantum communications

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Enabling the development of thin film technology

Helping thin film technologies become a reality

Thin film materials possess novel properties not found in bulk materials, enabling their use in the production of flexible LCDs or solar panels that can be fixed to the outside of windows.

The production of thin films is currently limited due to a lack of understanding of precisely how changes in the composition and structure of thin film materials affect properties such as electronic and thermal conductivity.

This project will improve the nanoscale measurements needed for developing thin film technologies, thereby improving our understanding of film properties and reducing material and energy costs. This should increase the uptake of the novel and beneficial applications of thin films - with European industry taking the lead.

Project IND07: Metrology for the manufacturing of thin films

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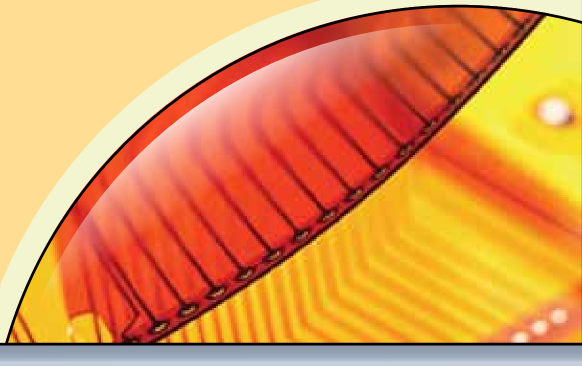

New and advanced magnetic sensors

Improving high-resolution electronic measurements

Magnetic sensors are used in industries that require accurate high-resolution data, for example consumer electronics, information and communication technology (ICT), and the car industry.

This research will develop methods for characterising new magnetic materials that could increase the efficiency of electrical equipment and help to calibrate magnetic sensors, both reliably and cost-effectively.

The improved understanding of the physical properties of magnetic materials brought about by this project will enable sensor manufacturers to develop advanced anisotropic magnetoresistance (AMR) sensors that are ultra-small, with low-noise and high-sensitivity, and will also improve electronic measurements. These improved measurements will, in turn, lead to more advanced products.

Project IND08: Metrology for advanced industrial magnetics

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Ensuring rapid changes in force do not affect measurement

Force, torque and pressure measurement over time

Many industries would benefit from more accurate dynamic measurements of mechanical quantities such as force, torque and pressure. However, measurements of these quantities are presently based on static calibrations, even though it is accepted that measurement instruments behave differently when the force changes over time.

This limitation is significant and impacts the automotive, aerospace and transport industries. For example, it impacts safety assessment measurements in car crash testing and the characterisation of the strength of weight-saving materials used in both cars and planes.

The project will establish traceable dynamic measurements for force, torque and pressure, and will produce precise dynamic mechanical test signals to improve the safety of industrial systems.

Project IND09: Traceable dynamic measurement of mechanical quantities

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Measuring optical curved surfaces

Characterising free-form 3D surfaces

Measurements of the full 3D form of optical curved surfaces is important for characterising surfaces used in the optics and precision engineering industries as well as in astronomy and science.

Currently, two types of measurements are used; imaging or single point scanning – both of which have advantages and disadvantages that limit manufacturing capability. This project will create standards and will perform comparisons so that reliable characterisation of a full 3D free-form surface is possible.

Once characterised, advanced optical surfaces can be used to calibrate instruments used in precision engineering and scientific projects such as the European X-ray Free Electron Laser (XFEL), which aims to map the atomic structure of viruses and view them at the nanoscale in 3D.

Project IND10: Optical and tactile metrology for absolute form characterisation

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Advanced assessment of engineered surfaces

Reducing wear and friction in components

An estimated loss of 2 % of GDP in developed countries is attributed to losses caused by friction and wear. Therefore, advances in surface engineering, such as low friction coatings on machine components will improve industrial efficiency and the sustainability of transport, power production and manufacturing.

This project will develop advanced measurements from the macroscale to the nanoscale for the assessment of engineered surfaces.

This will lead to an improvement of surface engineering, for example reducing downtime and waste in aluminium forging or increasing the lifetime of mining components used to drill for oil. There could also be health benefits, as high durability coatings can eliminate the health risks posed by contamination of food products during processing.

Project IND11: Metrology to assess the durability and function of engineered surfaces

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Understanding industrial vacuums

Improving vacuum measurements for better end-products

Historically, vacuum has been an important tool in industry and has been used in many applications, ranging from protecting light filaments from chemical degradation to controlling the flow of current in electronics.

The use of vacuum is still important today, in modern lighting, the semiconductor industry and fusion power research. However, vacuum is poorly understood when used outside the laboratory, as traditional measurements are unsuitable and based on the pressures of pure gases in stable conditions.

This project will improve vacuum measurements in conditions representative of those found in industry. The improved measurements will lead to a more efficient use of vacuum and better end products.

Project IND12: Vacuum metrology for production environments

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Stable and reliable measurement systems

Measurement consistency with time and temperature

The continuing development of advanced industries such as ICT and aerospace requires constant improvement in the accuracy of high-end production equipment and measurement devices.

However, material properties change over time and with temperature fluctuations, which reduces the reliability and performance of systems and means that current state of the art measurement equipment needs regular recalibration.

An increased understanding of measurement drift over time, better temperature control and improved thermal design are therefore necessary to meet industrial demands. This project will perform thermal modelling on a prototype measurement device in order to explore how devices can be improved to increase their stability over time and with changes in temperature.

Project IND13: Thermal design and time-dependent dimensional drift behaviour of sensors, materials and structures

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Improving the accuracy of atomic clocks

Accurate atomic clocks for industry

This research will develop new standards to improve the stability of the high frequency atomic clocks used to provide satellite navigation systems and fast internet access.

Current atomic clocks housed in laboratories meet performance requirements; however, these need to be smaller and capable of operating in harsh environments to be used in industrial environments. This project will improve the robustness and portability of atomic clocks and aims to qualify such clocks for use in satellites in space.

This research should result in individual clocks becoming more stable and improved synchronisation between them, allowing higher speed data transfer with fewer errors and more reliable systems for industry and consumers.

Project IND14: New generation of frequency standards for industry

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Understanding chemical interactions at surfaces

Improving the speed and efficiency of industrial processes

Accurate chemical measurements at surfaces are vital for all areas of engineering and industry that rely on surface analysis. This includes microelectronics, the development of corrosion resistant materials in aerospace, the assessment of the toxicity of medical implants and the design of industrial catalysts.

The properties of a surface and of the bulk material can be markedly different, with bonding, wettability, cell adhesion and reactivity all radically affected by surface chemistry.

This project will provide reference materials and develop methods for the highest priority industrial applications leading to cost and time improvements for many industrial processes across Europe.

Project IND15: Traceable quantitative surface chemical analysis for industrial applications

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Increasing frequencies for communications technologies

Enabling the efficient use of higher frequencies for communications

High-speed communications develop rapidly and in 2009 $40.3 billion was invested to deploy 4G technology worldwide. But as more and more commercial communications and sensing systems go online, the frequencies available for use need to be increased - to levels above 77 GHz which were previously only used for research purposes.

These higher frequencies need to be accurately measured in order to use the additional bandwidth efficiently, but currently it is difficult to measure signal characteristics such as phase and amplitude at these levels accurately.

This project will provide solutions to the high frequency signal measurement challenges. The results could make or break the next generation of communication technologies in Europe.

Project IND16: Metrology for ultrafast electronics and high-speed communications

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Underpinning small structure measurement

Supporting the miniaturisation of technological components

The reliable measurement of small structures, less than one micrometre in size, is necessary to develop optical and semiconductor technologies that are dependent on the miniaturisation of components.

Scatterometry is a tool that measures by scattering light across a surface and detecting the reflections. It is relatively fast compared with traditional techniques such as Scanning Electron Microscopy (SEM) and Atomic Force Microscopy (AFM), and could be more widely used during manufacturing processes were it not for a lack of universal standards.

This project will provide a scatterometry reference standard, also suitable for testing AFM and SEM devices that will add traceability to scatterometric measurements and make them comparable to microscopic methods.

Project IND17: Metrology of small structures for the manufacturing of electronic and optical devices

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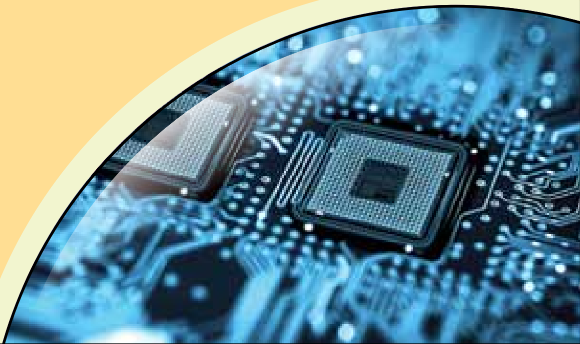

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