European Metrology Research Programme

Delivering Impact

Measuring organic layers

Many innovative products - from touchscreens to solar panels to pharmaceuticals – utilise multiple organic layers to create complex functionality. New techniques have been developed to remove and measure layers individually enabling improved product development and assisting with quality assurance. However, manufacturers cannot be certain of the depth of layer being removed and new reference materials for these techniques are needed to increase uptake, and remove a major barrier to innovation.

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

Many next generation technologies have multiple layers of organic materials with complex surface chemistries. For example, in mobile phones these layers provide visual displays, touch response and protection. Organic solar cells require multiple layers to turn light into electricity. Drug delivery systems are designed to break down in very specific ways to deliver the correct dose over the prescribed time.

Innovation in such technologies requires an understanding of how surfaces, interfaces and thin layers behave at the molecular level, and how this effects performance in the final product.

Measuring these multiple organic layers requires surface layers to be individually removed without damage to the freshly exposed surface. Instruments that can do this accurately will speed innovation through enabling a better understanding of how molecules are distributed, thereby providing confidence in the performance and reliability of new products. However it is currently hard to be certain of the depth being removed, making it difficult for manufacturers to be confident in which layer they are measuring.

In order for these techniques to deliver their potential, and support innovation in organic thin film chemistry, it is necessary to develop methods which provide users with certainty about the depth of material being removed.

Solution

The EMRP project *Traceable quantitative surface chemical analysis for industrial applications* developed two certified organic reference materials for depth analysis of layered organic materials. The reference materials consist of stacked layers of different organic molecules with different mixtures and accurate layer thicknesses. These were validated using X-ray Reflectometry, an existing traceable measurement technique.

The organic reference materials now enable calibration of a range of depth profiling technologies for organic materials. This holds huge potential for manufacturers in many industries, who require reliable ways to measure surface chemistry of organic layers, improving both quality assurance and R&D.

Impact

The new reference standards have generated widespread interest from surface analysis instrumentation suppliers. Kratos Analytical Ltd, makers of state-of-the-art spectrometers for surface and biochemical analysis, is one of several early users of these reference materials. Kratos has improved their X-ray photoelectron spectroscopy (XPS) technology, which incorporates a technique for removing layers one at a time using a stream of argon cluster ions, each cluster containing hundreds or thousands of argon atoms and measuring the freshly exposed surface by electron spectroscopy.

Kratos was keen to introduce reference materials to demonstrate the viability of XPS for analysing individual organic layers. The standards developed by this project mean they can better characterise their instrument performance, and provide confidence to customers. This will facilitate XPS acceptance in a number of industries, and increase the potential market for Kratos's instruments.

The improved ability to use techniques such as XPS to determine the chemical composition of organic layers using depth profiling is making a significant contribution to research and product improvement in this area. This brings important benefits to manufacturers of complex layered organic materials such as display screens and solar panels, including Kratos's customers.

Traceable quantitative surface chemical analysis for industrial applications

Surface chemical measurements have provided a foundation for the development of products in many sectors including chemicals, fuels, semiconductor devices and biomedical devices. However, an improved metrological infrastructure is now needed for continued product development and quality control by European manufacturers.

The EMRP project *Traceable quantitative surface chemical analysis for industrial applications* has addressed this by developing new certified reference materials and methods to improve analytical instrumentation traceability. As a result of the project, instrument manufacturers and researchers can have greater confidence in the comparability of surface chemical analysis results. This will speed the introduction of complex measurement techniques such as EPMA EDS, the use of Argon cluster sputtering for the analysis of layered organic films and the use of XPS and TofSIMS to perform multiple species analyses in a single biological sample measurement.

EMRP
European Metrology Research Programme
Programme of EURAMET

The EMRP is jointly funded by the EMRP participating countries within EURAMET and the European Union

www.euramet.org/project-IND15

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11326/0916 - IND15 16011