European Metrology Research Programme

Delivering Impact

Simpler disease diagnostics

Biomarkers are small molecules found in the bloodstream, which can be directly related to diseases such as cancer, HIV and Hepatitis. At the heart of many new diagnostic tools, biomarkers enable early detection of disease making successful treatment more likely. However, their small size and often low numbers can hamper detection without expensive specialist equipment. Innovation in measurement cell design is needed for simple and low-cost biomarker detection in complex samples.

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

Certain molecules within biological samples - known as biomarkers - can be indicative of serious diseases, such as cancers, HIV and Hepatitis. Detecting their presence and determining how these small molecules interact with each other and cells in the body holds considerable potential for developing new diagnostic tools which detect disease much earlier and help understand how new treatments perform.

In order to aid their detection, biomarkers are often bound to a probe molecule, which has a specific property that enables it to be imaged - for example it fluoresces. However, this process often involves complex preparation methods, specialised equipment, and requires highly trained staff. Although they offer large benefits, current detection methods are both complex and costly.

Simple, cost effective and fast detection methods, with potential for use in a clinical setting are needed. Significant problems in developing new diagnostic methods using probe-biomarker combinations are the lack of an easy sample preparation method and suitable containers to hold naturally wet bio-samples during analysis by routine laboratory instruments. New measurement cells that match these needs are required as a pre-curser to developing new point of care methods for disease diagnosis.

Solution

The EMRP project *Metrology for the characterisation of biomolecular interfaces for diagnostic devices* successfully demonstrated a new easy-to-use sample cell for detecting single biomarkers in real biological samples.

A group of researchers at Chalmers University of Technology in Sweden tested the performance of this novel measurement cell by detecting Alzheimer's biomarkers in human cerebral spinal fluids and were able to distinguish between samples from healthy individuals and patients suffering from Alzheimer's.

The cell is designed as an add-on to be used with a standard optical microscope. It produces an image of the cell-sample interface by binding biomarkers down to the cell's surface in a highly selective manner. This simple system enables fast single biomarker detection in a highly complex biological sample. The innovative measurement cell and its novel method of containing and positioning liquid bio-samples for optical analysis is being patented prior to commercialization.

Impact

Researchers at BOKU University in Vienna and the University of Göttingen, are already using the Chalmers' measurement cell to study biological reactions. There has also been considerable interest from a major drug company. The device has potential to be developed into a simple diagnostic device for detecting a range of specific biomarkers. This could lead to on-the-spot tests for cancer, Alzheimer's disease and viral infections such as HIV and Hepatitis.

Researchers involved in drug discovery are also excited by the capability this cell presents to observe binding and unbinding of biomarkers as this opens up the possibility of studying the making and breaking of bonds between biomarkers and surface functionalized molecules. Understanding these chemical interactions is hugely important for research into viral infections, cell-to-cell communications in cancer and degenerative diseases, as well as in drug delivery systems.

Improving our understanding of the functions and interactions of small molecules in the body will increase our knowledge of some of the world's most devastating diseases, which will help researchers and doctors reduce suffering through earlier diagnosis and more effective treatment.

Metrology for diagnostic devices

The EMRP project *Metrology for the characterisation of biomolecular interfaces for diagnostic devices* developed methods and reference materials to reliably and consistently measure the performance of biochemical interfaces used in in-vitro diagnostic devices (IVDs). These biochemical interfaces detect target molecules in patient samples that are indicative of disease, infection or other adverse health conditions. The project developments will allow IVD manufacturers to develop increasingly accurate and reliable devices for a broader range of health conditions, resulting in faster diagnoses at the point of care and driving down healthcare costs in Europe.

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