Healthcare industry BW

Personalised cancer therapy based on microRNA analysis

microRNAs are not just required for the regulation of gene expression, their expression signatures also allow conclusions to be drawn on the type and progression of cancer. Sensovation AG is therefore working with partners from industry and clinical research to develop an automated microRNA analysis platform that can detect and evaluate microRNA signatures faster than has previously been possible. The system is designed to make it easier to identify certain cancers and deliver more efficient therapy.

In recent years, microRNAs have emerged as a promising subject of research in molecular biology. microRNAs are relatively small segments, around 22 nucleotides long that are encoded by the genome of an organism. In contrast to mRNA, microRNA is a non-coding RNA molecule, which means that it is not translated into a protein. Instead, microRNAs affect the expression of genes by binding to the relevant mRNAs and preventing their translation or inducing their degradation. microRNAs also have a modulatory effect on many cellular processes and have been shown to play a role in the pathogenesis of cancer – although exactly what form this takes is not yet clear.

“microRNAs have been shown to have typical expression patterns for certain diseases, including some types of cancer,” says Dr. Hanswilly Müller, Head of Marketing at Radolfzell-based Sensovation AG. The company specializes in optical detection and analysis devices as well as imaging-based sensor systems and devices. One of its current projects involves microRNA analysis. The analysis of microRNA signatures can be used to identify tumours and their origin, as well as for the typing of different cancers, and the findings can be used for the diagnosis and prognosis of the disease. As microRNA molecules are more stable than mRNA and their patterns are relatively static, microRNAs are reliable markers for medical research.

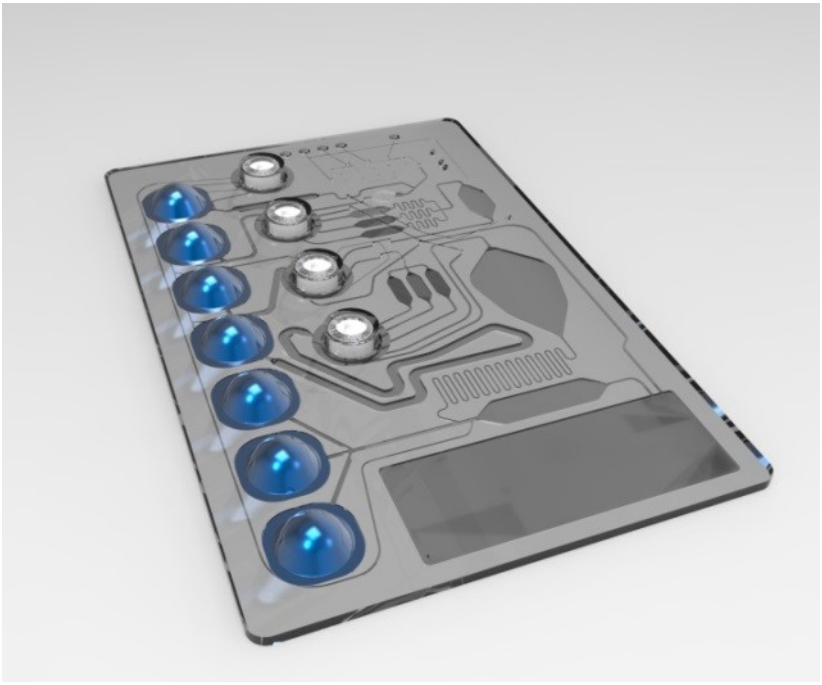
Complex microRNA patterns analysed automatically

In order to analyse microRNA signatures, Sensovation AG’s read-out system will be modified to work with microfluidic chips.

“microRNAs have huge potential in the diagnosis of diseases such as cancer. However, microRNA analyses have not yet become part of routine diagnostics,” says Dr. Müller. The challenge as far as the analysis of microRNA signatures is concerned is the need to analyse a large number of microRNAs in order to obtain a clinically relevant microRNA signature. "And the signature must be detected in parallel. This is what we call multiplex diagnostics, and Sensovation AG has offered multiplex solutions for many years," says Müller.

Sensovation is putting its expertise in multiplexing to good use in a project that is being carried out in cooperation with partners from industry and science. The project is aimed at developing a microRNA analysis platform. The new system will enable automated processing and analysis of samples, thus making it much easier to identify microRNA patterns. “Experts from science and industry are working closely together to combine a large number of details from different disciplines,” says Dr. Müller describing the cooperative venture.

Multiplex diagnostics and microfluidics – with high-tech to simple application



The new microfluidic chip enables automated processing of the sample and analysis of microRNAs.
© microfluidic ChipShop

Special microarrays that are able to detect not only one, but 20 to 30 microRNAs simultaneously in one experiment form the basis of the new analysis platform. This multi-parameter approach significantly reduces the number of steps involved in the analysis of complex patterns, thus making diagnosis much faster. In contrast to Sensovation AG's previous multiplex diagnostics applications (see article entitled "Sensovation AG: a special camera for rapid allergy diagnosis", see link on the right-hand side), the microarray is not integrated into microtitre plates, but into a specifically developed microfluidic chip. The chip consists of a plastic plate with small chambers that are used as reaction vessels. As the chambers contain all the substances that are necessary for the preparation of the samples, the microfluidic chip enables automated extraction, processing and detection of patient samples.

While the cooperation partners are working on the standardization and miniaturization of the sample preparation steps in the microfluidic chip as well as the isolation and detection of microRNA signatures, Sensovation is, amongst other things, tasked with the development of the central control system, handling of the liquids and development of a suitable reader. Since the analysis of microfluidic chips differs from that of a microtitre plate, the cooperation partners will also have to modify the analysis device. "The detection system needs to be completely remodelled and adapted to the new requirements. Instead of X-Y-Z axis movements, the new system must be able to accurately control the temperature range in the samples," says Dr. Müller, pointing out the challenges that the company faces.

Effectively detecting and treating cancer

The project partners will initially use the new platform to detect known characteristic microRNA signatures whose correlation with clinically relevant parameters has already been demonstrated. The clinical project partners are however also interested in including new microRNAs in the analyses. "This enables us to obtain new findings very early on in the project and cover a broad range of analytes with the test system," says Dr. Müller.

Once the project phase is complete, the system will primarily be used in microRNA research. "We hope that microRNA diagnostics will also become an integral part of clinical diagnostics, and thus facilitate the detection and specific therapy of certain cancers," says Dr. Müller, who hopes that the project will therefore close a gap between scientific research and routine medical diagnostics.

The IMRA project

The isothermal, multiparametric RNA project, IMRA for short, is funded by the German Ministry of Education and Research's KMU-innovativ: Biotechnologie – BioChance funding programme and focuses on the development of an automated platform for the detection of microRNA signatures. The project was initiated in 2012 and will run for three years. In addition to Sensovation AG, which is coordinating the project, IMRA also involves Scienion AG, microfluidic ChipShop GmbH, the Institute of Microsystems Engineering at the University of Freiburg (Laboratory for Sensors and CPI) as well as the Freiburg University Medical Centre's Department of Gynaecology (Prof. Dr. med. Elmar Strickeler) and the Institute for Pathology (Prof. Dr. med. Martin Werner).

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