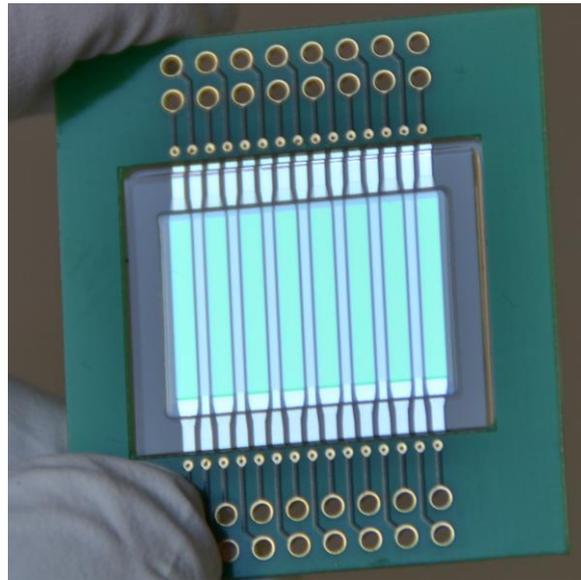


Quick test for high milk quality – researchers are developing sensors as an early warning system for contaminants

Harmful substances can get into milk in various ways. That's why Fraunhofer researchers from two institutes are working together with partners on a new concept for optimising production based on the entire delivery chain. The early warning system is intended to help the industry reduce costs, time and gallons of product waste in the future.



Chip with light sources and light detectors for the analysis of harmful substances in milk.
(Photo: © Fraunhofer FEP)

More safety in milk production

Food safety and quality have reached a high standard in Germany and the European Union. This is also true for the milk industry. To prevent contaminated milk from entering the food chain, inspections are carried out during the entire production process and along the entire delivery chain. However, these standard tests entail great expense with regard to costs and time. The samples analysed in laboratories are taken from tanks of collection vehicles with mixed milk from several dairy cattle farms. If it is determined that the milk is contaminated, enormous quantities must be destroyed, which is tied to high losses for the farmers and dairies concerned. This could be avoided if the milk were to be tested directly on the farm before it is brought to the collective transport.

Quality check provides measured values in five minutes

In the EU project MOLOKO, twelve partners – including a dairy – from seven countries have found a solution for detecting contaminants significantly cheaper and faster: A new opto-plasmonic sensor is to act as an early warning system and as an additional check before the milk

is put in the tank. The analysis for six ingredients takes approximately five minutes. The sensor is functionalised with specific antibodies for various parameters of milk safety and quality and enables the automatic quantitative analysis directly on site on the farms.

Sensor analyses harmful substances and proteins

The entire system consists of a micro-fluid, reusable chip, organic light-emitting transistors (OLETs) or diodes (OLEDs), organic photo-detectors (OPDs) or the sensor, a nano-structured plasmonic grid and the specific anti-bodies. The Fraunhofer-Institut für Organische Elektronik, Elektronenstrahl- und Plasmatechnik (FEP - Fraunhofer Institute for Organic Electronics, Electron Beam and Plasma Technology) is developing the organic photo-detector and the Fraunhofer-Institut für Elektronische Nanosysteme (ENAS - Institute for Electronic Nanosystems) the micro-fluid chip. The OLET and the photonic grid are being developed in Italy by the CNR-ISMN in Bologna and the company Plasmore in Pavia.

"The special thing about our chip is that it can be reused. This is made possible by separating the target molecules from the immobilised anti-bodies using a regeneration buffer so that they can be used again for a new verification", explains Andreas Morschhauser, scientist at the Fraunhofer ENAS. The chip is designed for hundreds of measurements. Six parameters and proteins can be analysed with each measurement. For this purpose, Morschhauser and his colleagues are developing the micro-fluid system in the form of a replaceable, automated, miniaturised cartridge. "In addition to the information collected on the milk, the measured parameters also allow conclusions to be drawn on the health of each individual cow", says Morschhauser. Farmers receive a broad range of information on their condition. For example, this enables infections to be detected at an early stage and treated immediately. "This can contribute to a prudent use of antibiotics, and therefore also to their reduction", says the scientist.

Quality check not just for milk

But how does the verification work? "The transistor generates light that falls on the grid coated with anti-bodies. These are specific for the relevant ingredients. If the milk is washed over the anti-bodies, the target molecules bond to them. This changes the refractive index in the area around the grid, which leads to a change in the reflection of the light. The reflected light falls on the photo-detector, which measures the minimal change in the refractive index", says Dr. Michael Törker, scientist at the Fraunhofer FEP in explanation of the measuring principle. The basic effect is referred to as surface plasmon resonance and occurs among other things on specially structured nano-grids. "The effect permits fast, very sensitive measurements", says Törker.

The biosensor is to be used at various points on the value-added chain - both as a laboratory device and integrated directly in milking systems. However, the system is not only suitable for checking the quality of milk. Other liquids, e.g. beer or water, can also be analysed with the opto-plasmonic sensor in the future. "To do this, it is only necessary to adjust the immobilised capture molecules", says Andreas Morschhauser. For this purpose, the capture molecules only need to be replaced and adapted accordingly.

Additional information and contact

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