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Sensor Technology For Food And Beverages Control

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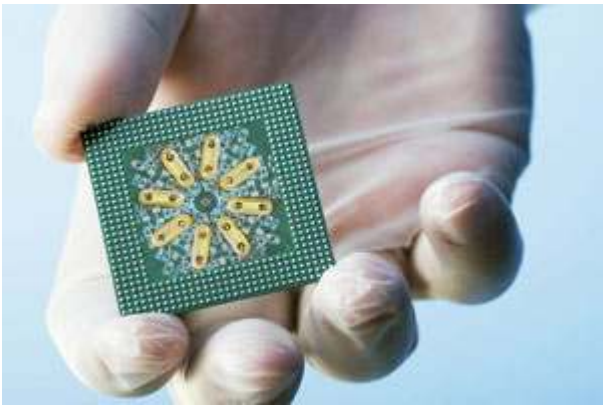
Sensors designed for the detection and identification of contaminants in food quality and food safety applications are used throughout the food manufacturing process. The detection sensors capabilities are often used "in-line" and are integrated directly into existing manufacturing lines or as part of "stand-alone" devices contained in rapid and portable detectors. Common applications of detection sensor capabilities in the food manufacturing process include process monitoring, shelf-life investigation, freshness evaluation, authenticity assessment and other quality control studies.

One of current drawbacks in food inspection methods is, for example, the complexity of most food aromas, which make them difficult to be characterized with conventional flavor analysis techniques, such as GC-MS. Another example is sensory analysis by a panel of food experts, which is a costly process since as requires trained professional who can work for only relatively short periods of time; additional problems, such as the subjectivity of human response to odors and the variability between individuals are also to be considered. Consequently, the need for reliable food sensor technologies whose strengths include high sensitivity and correlation with data from human sensory panels for several specific applications in food and beverage control remains unmet.



A significant emerging development in the food sensors industry is based on a novel and patented scientific approach in using High-Frequency Quartz Crystal Microbalance (HF-QCM) detection method. It is based on the piezoelectric theory where molecules adsorbed on the surface of selective chemical or biological coatings create changes in the mass weight of the HF-QCM-based sensors. This process affects their resonating frequency and provides a unique digital signature or fingerprint for each target substance. The changes are accurately measured within seconds through a combination of HF-QCM-based sensors and powerful pattern recognition algorithms. Sensors using the HF-QCM detection method are capable of analyzing target molecules in non-contact vapor sampling and/or surface swipe techniques while reaching high sensitivity levels of: $1x10^{-9}$ grams up to $1x10^{-12}$ grams.

Sensors using the HF-QCM detection method can also be recalled as "Electronic-Nose" and "Electronic-Tongue". Such sensors are capable of operating at relatively low-temperatures when necessary, have short calibration and training requirements, fast recovery time between runs and maintenance procedures to maintain low-operating

costs. HF-QCM-based sensors also have short recording and analysis times, particularly when used in highly stable "plug & play" sensor arrays. As most applied markets and industries tend to move more toward miniaturization of analytical laboratory instrumentation, the current approach strives for the development of innovative food sensors, which will be gradually integrated "in-line" and/or as "stand-alone" rapid and portable detectors. The results can be stored and processed by integrating the sensors in suitable computational analyses.

The inspection capabilities of food manufacturing operations can be significantly upgraded by utilizing the HF-QCM detection method in the deployed sensors. HF-QCM offers a complementary and/or alternative detection method to traditional analytical chemistry instruments currently used in many food manufacturing and inspection activities by providing operational advantages and added values related to sensitivity, selectivity and durability in field operations.

The main advantage of HF-QCM as a detection method is the ability to determine the presence or absence of contaminants and related chemicals within seconds, even in field operations. HF-QCM provides real-time analysis, quick recovery and exceptionally high sensitivity to a wide range of target substances. HF-QCM technology can benefit food manufacturers with quality control assessments, brand recognition, product consistency, shelf-life taste, smell characteristics off-flavors, product variety assessments, manufacturing processing controls, product characteristics and consistency, product uniformity aroma and flavor characteristics. The key for forming consistent and reliable results is also support by a remote ability to form an upgradeable database of materials and their detection algorithms.

Detection sensors using the HF-QCM detection method are also available for integration into hand-held detectors with wireless transmission capabilities. This approach is targeted to assist food inspection personnel as well as improving response and recovery in case of food contamination outbreak by enabling a real-time transmission of results to command and controls centers. The real-time reporting of data and processing of data will increase consumer protection, increase public confidence and increase production at food manufacturing facilities. Consistency in food quality will protect both manufacturers, consumers and increase public health. It can also result in dramatic cost savings from other costly HPLC and GC-MS based instruments and the independence from human sensory inspections.

In conclusion, novel food sensors play a significant role in the detection and identification of contaminants during the food manufacturing processes. Electronic Food Sensors can also help scientists develop new methods for keeping consistency of the aroma and flavor of products, as well as exploring ingredients to mask undesirable aromas. Advantages of food sensors include real-time analysis, high sensitivity, reproducibility, selectivity and mobility, low cost-of-ownership and gradual replacement and/or parallel use to complex and cumbersome analytical laboratory instruments. Whether used "in-line" or as "stand-alone" the sensors can be integrated in conjunction to Wi-Fi technologies and used for real-time transmission of contamination alarms and/or test results to remote servers. The potential result is low-power consumption, humidity-resistant and cost-effective portable detection devices and/or a network of sensor arrays providing rapid screening, monitoring and reporting.

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