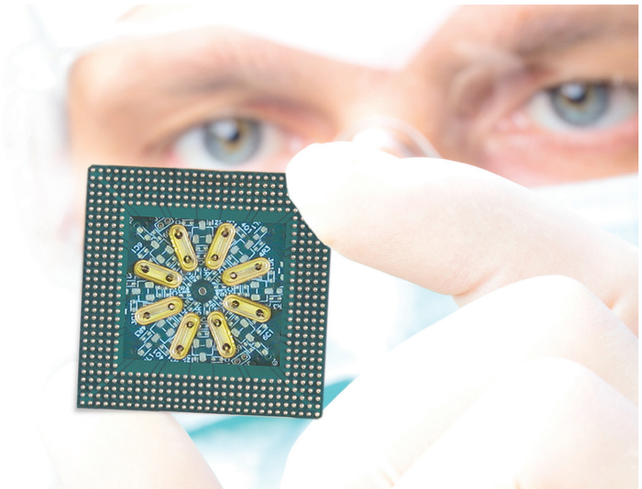
MS TECH
Advanced Sensor Technologies

HF-QCM

HIGH-FREQUENCY QUARTZ CRYSTAL MICROBALANCE SENSORS

GPS

MS Tech developed a wide range of HF-QCM Sensors based on a multi-disciplinary approach that integrates: QCM technology, plasma etching, chemical coating and deposition technologies, micro-mechanics, electronics, algorithms and digital data processing.



The scientific development includes a large bank of thin chemical coatings (polymers and SAM›s) that can be applied on the active surface of HF-QCM Sensors. Each of these coatings has a specific affinity to different substances and is designed to selectively interact with the target molecules.

The sensors are formed in a patented Sensor Matrix structure that offers high sensitivity and selectivity to a wide range of molecules (See Figure 1). The sensitivity of a HF-QCM sensor is proportional to a square of frequency of the quartz resonator and is defined by expression, in which the sensor frequency change depends on the adsorbed mass as follows:

$\Delta f = (-2.3 \times 10^{-6})\, f^2\, \Delta M/A$,

*Where: Δf[Hz] – frequency change under the influence of adsorbed mass ΔM;

F (Hz) – resonance frequency of quartz sensor;

A (cm^2) – electrodes area (two sides) of quartz sensor where is accumulate of adsorbed mass ΔM;

Figure 1: An Overview of HF-QCM Sensors developed by MS Tech

The HF-QCM Sensors have the capacity to detect and identify traces of materials in gas, vapor and liquid phases, even at very low concentrations. The sensors can be operated in a wide ambient temperature range (-10°C to +60°C) and at a humidity range of 5% to 95% RH without condensation

Scientific Principle of Operation

The HF-QCM Sensor Technology is an amalgamation of several scientific disciplines,digitally recreating the mammalian olfatory processes (See Figure 2) for Sensor Matrix interacting with molecules).

It is based on the piezoelectric theory where molecules adsorbed on the surface of selective chemical coatings create changes in the mass weight of the HF-QCM 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 Sensors and powerful pattern recognition algorithms.

Figure 2: An inside view of the HF-QCM Sensors

Figure 3: Sensor Matrix Chip Design

Typical Response Curves

The dynamic range of resonating frequency of HF-QCM Sensors is typically between several to a few hundred MHz. In each sample analysis, the frequency responses of all sensors are measured over pre-determined time intervals. The sample identification process occurs when pattern recognition algorithms process the received digital signature and match it with an existing database of substances stored in the instrument. The HF-QCM Sensors responses create a digital signature characterizing the HF-QCM Sensor Matrix reaction to a specific material inserted for analysis (See Figure 3 and Figure 4). The Sensor Matrix response for a given sample is systematically measured and consistent, to the extent that the likely ranges of target molecules and typical interferents have been previously inserted to the database. The distribution of the Sensor Matrix responses to analyzed samples can be plotted as histograms. This technological concept enables a fast adaptation and flexibility in "learning" to detect and identify new target substances while keeping low false alarm rates

Design Review

The HF-QCM Sensor Matrix is designed as a "plug & play" chip that does not use any radioactive source or hazardous materials (See Figure 5). It can be integrated in a wide range of systems while maintaining sensitivity and selectivity during high-throughput analysis. Each HF-QCM Matrix can record and store thousands of samples performed since its installation. It can also be integrated in conjunction to Wi-Fi or Bluetooth and used for real-time transmission of alarms and/or test results to remote proxy servers. The result is compact, low-power consumption and humidity-resistant detection devices.

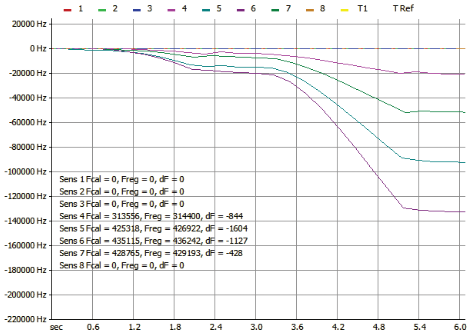


Figure 4:
Digital signature of Cyclotrimethylene-trinitramine (RDX) showing the response curves of the HF-QCM Sensor Matrix to a plastic explosive material.

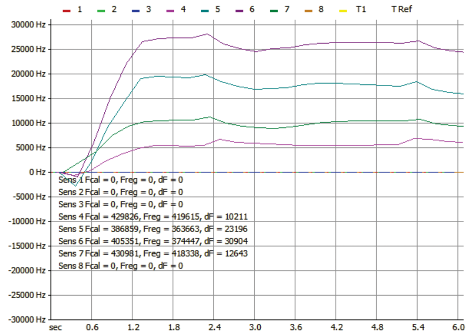


Figure 5:
Digital signature of Triacetonetriperoxide (TATP). Peroxides have a wide commercial use as bleaching agents and polymerization catalysts. Due to the weak O_Obond peroxides undergo facile thermal decomposition to produce radicals. Many peroxides are shock sensitive and their overall decompositions are exothermic leading them to detonate easily.

Feature Highlights

- Green technology
- No radioactive source
- High sensitivity & selectivity
- Short response
- Fast recovery time
- High stability
- Real-time transmission
- Energy efficient
- Low-power consumption
- Resistance to humidity
- Resistance to barometric pressure
- Maintenance free sensors
- Low manufacturing costs

Market Applications

- Explosives & improvised materials
- Narcotics & contraband
- Toxic Industrial Chemicals (TICs)
- Chem-bio agents
- Pathogens
- Chemical contaminants
- Spoilage organisms
- Automotive (CO and NO2)
- Air quality (CO and VOCs)
- Safety (CH4, propane)
- Consumer (VOCs)

ANTEVORTA

HF-QCM™ onboard processor automatically transmits the data to an Android or iOS application and includes all data logging, including time, date, and sample analysis for each alarm. A complete history of saved data and alarm files can be viewed, analyzed, downloaded and printed at any time.

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