Northeast GAS ASSOCIATION
NYSEARCH

Technology Brief

Next Generation Micro-Resonator Based Methane Sensor for Residential Applications

Description: **A robust, low cost and reliable methane sensor, based on Micro-resonator technology developed and tested for residential applications.**

Status: **Sensor proven in extensive laboratory testing. Completing UL Certification testing and undergoing customer pilot tests.**

BENEFITS

Methane detectors have a wide variety of applications in the natural gas industry and meet stringent needs of the local gas distribution companies. In searching for a next generation methane sensor, in 2009, NYSEARCH identified a sensor technology commercialized for a different industry that is accurate, low cost and most importantly, it operates differently from traditional methane detectors that are established as a consumer application. This Micro-Resonator technology is not susceptible to contamination or false alarm in the presence of household chemicals and other interferents.

BACKGROUND

A number of instruments are available in the market that measure concentration of methane and/or combustibles. They vary in accuracy, range, price, and calibration needs. Typically, low cost sensors suffer from reliability and robustness issues, resulting in many false positive alarms. Sensory technologies have advanced in the last decade. Through the Oracle project, NYSEARCH has identified the micro-resonator technology as a technology able to provide all the features needed.

TECHNICAL APPROACH

NYSEARCH completed a feasibility study, product development and test program with Applied Nanotech, Inc. of Austin, TX, to determine whether a miniature methane (natural gas) sensor could be developed based on its micro-resonator technology, with a range of zero to 100% methane in air or nitrogen, a detection limit of 0.25%, and a resolution of 0.1%.

A micro-resonator is a sensor able to measure the viscosity of a gas mixture. Changes in gas composition give rise to changes in the oscillation frequency of a tuning fork or microresonator (MR) that oscillates within the gas. This methane sensor uses a pair of quartz tuning forks (see Fig. 1) oscillating at a very high frequency. The frequency difference between a measuring microresonator and a reference microresonator enclosed in a vacuum package will be proportional to the methane concentration in a mixture of natural gas and air. Since the resonance frequency of a microresonator depends on the ambient temperature and pressure, the MR sensor provides

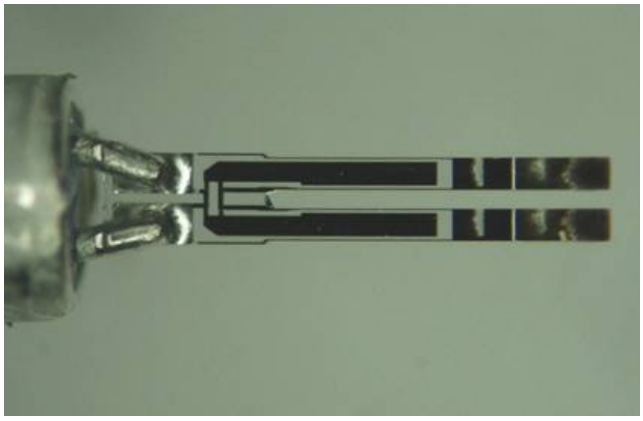

Figure 1: Tuning Fork Used in the MR Methane Sensor

proper compensation against variations of ambient conditions. Given that sensor elements have both digital and analog outputs, the system has an analog-to-digital converter integrated into it.

Based on the test results of sensor performance in different environments, the design, hardware and algorithms of the sensor have been optimized. Prototypes of both an analytical instrument and a residential safety detector were built and tested. The analytical instrument has a display and controls for setting various operating parameters and has an RS-232 connector for interfacing with a computer. The residential detector has no control options but includes an alarm buzzer and back-up battery.

Following rigorous testing, the MR sensor design proved to be fully resistant to household and industrial chemicals and an excellent application for use in the residential detector market. This contrasts with a variety of commercial detectors that are compromised by various chemicals.

PROGRAM STATUS

The development and testing of engineering prototypes of both the analytical instrument (Fig. 2) and the detector have been completed and have shown that all specifications have been met.

The development of a pre-commercial residential detector was carried out as per applicable UL 1484 standard. Following optimization for low power consumption, manufacturability and low cost, its performance was validated prior to submitting to UL for certification. The advanced pre-commercial residential detector package, as submitted for UL testing, is shown in Figure 2.

Following successful completion of the UL certification testing, a pilot testing program is being carried out in order to test the detector in various residential environments. Concurrently, a commercialization process is being pursued.

Figure 2: Package of MR Methane Sensor for UL Testing

Highlights
METHANE SENSOR SPECIFICATIONS

• Concentrations range:	0 – 100%
• Operating temperature:	-20°C to 50°C
• Storage temperature:	-40°C to 90°C
• Relative humidity:	0-95%
• Ambient pressure:	30 - 110 kPa
• Response Time (T_{90}):	1 sec
• Alarm limit:	1%
• Accuracy:	0.25% of full scale
• Resolution:	0.1% of full scale
• Supply voltage:	5.0 VDC

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