

National Aeronautics and
Space Administration



Health, Medicine and Biotechnology

Nanosensor Array for Medical Diagnoses

A low-power, and compact nanosensor array chip

NASA has developed an innovative approach to improve the quality and convenience of medical diagnosis, and data transmission for immediate therapy. The new technology uses a network of nanochemical sensors on a silicon chip combined with a monitoring system composed of humidity, temperature, and pressure/flow sensors for real-time chemical and physical properties measurement of human breath for non-invasive and low-cost medical diagnosis. No such technology exists in the market today. Although many research activities are ongoing, NASA's technology is readily available for this application. With a detection range of parts per million (ppm) to parts per billion (ppb) this technology, called a nanosensor array chip, provides a highly-sensitive, low-power, and compact tool for in-situ and real time analysis. It changes the way and time decisions are made to help both patient and medical care provider to minimize their cost, optimize resources, reduce risk, and cut the amount of time needed for conducting a response.

BENEFITS

- Detection limit range: ppm to ppb
- Response time in seconds at 300 K
- Reproducible from sensor to sensor
- Low power: milliWatt /sensor
- Humidity effect is linear additive
- Easy integration (2-terminal I/V measurement)
- Sensor chip size is 1x1cm² with 12 to 96 channels
- Non-invasive
- Low cost
- Fast and accurate
- Multi sensors for comprehensive measurement
- Wired or wireless data transmission over a long distance

technology solution

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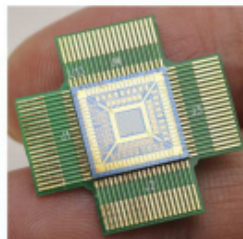


THE TECHNOLOGY

Many diseases are accompanied by characteristic odors. Their recognition can provide diagnostic clues, guide the laboratory evaluation, and affect the choice of immediate therapy. The study of the chemical composition of human breath using gas chromatography mass spectrometry (GC/MS) has shown a correlation between the volatile compounds and the occurrence of certain illnesses. The presence of those specific compounds can provide an indication of physiological malfunction and support the diagnosis of diseases. This condition requires an analytical tool with very high sensitivity for its measurement. A number of volatile compounds, so called biomarkers, are found in breath samples, normally at low parts per billion (ppb) levels. For example, the acetone in the exhaled breath from human with other biomarkers can indicate Type I diabetes. Usually, the concentration of the volatile compounds in human breath is very low and the background relative humidity is high, almost 100%. NASA's invention utilizes an array of chemical sensors combined with humidity, temperature, and pressure for real-time breath measurement to correlate the chemical information in the breath with the state and functioning of different human organs. This tool provides a non-invasive method for fast and accurate diagnosis at the medical point of care or at home. The sensor chip includes multisensors for a comprehensive measurement of chemical composition, temperature, humidity, and pressure/flow rate. The sensor data collected from this chip can be wired or wirelessly transmitted to a computer terminal at the doctor's desk or hospital monitoring center. The sensor chip can be connected directly or via Universal serial bus (USB) to a cell phone for data transmission over a long distance and receive an instruction from a doctor's office for an immediate therapy.



Cell phone sensor chip



Sensor Chip

APPLICATIONS

The technology has several potential applications:

- Medical diagnosis
- Nanotechnology
- Health monitoring
- Homeland security
- Biomedicine
- Aerospace

PUBLICATIONS

Patent Pending