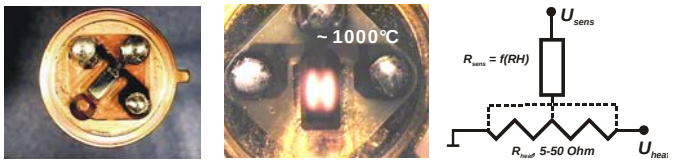
HUMIDITY SENSORS
TECHNOLOGY PROFILE

OVERVIEW

The featured humidity sensors are based on our patented microsensor platform technology. The sensors are produced from self-organized nanostructured aluminum oxide and are designed to perform in many environments where conventional RH sensor can not operate reliably or have a limited lifetime. Their advanced performance is enabled by two technological innovations: (1) uniquely engineered morphology and chemistry of ceramic sensing material at the nanometer scale provides a foundation for enabling its superior humidity sensing characteristics; (2) micromachining of alumina provides a miniature low power sensor design that supports sensor regeneration and new operating modes.



Packaged RH sensor and its equivalent circuit

SENSOR FEATURES:

Durability and Regeneration Capability

The sensors are mechanically robust and can operate in a broad temperature range, from as low as –60°C to as high as 500°C. Sensors can be regenerated from wetting, are resistant to environmental contamination and withstand direct contact with chemicals that foul polymer sensors.

High Sensitivity

Good sensitivity and log-log linearity was demonstrated in broad humidity (0.25 – 95%RH) and temperature (-15 - +30°C) ranges. Sensors with chemically modified alumina showed detection of as little as 10 ppm of water vapor.

Short Response/Recovery Time

The sensors have rapid response (1-10 seconds at 25°C, 15-60 s at –15°C) and recovery (3-15 s at all temperatures).

Repeatability

The sensors exhibit reproducible response, stable baseline, excellent signal-to-noise ratio and long lifetime.

Low Power Consumption.

Less then 100mW in *t-pulse* mode, ~1 mW in *passive* mode.

Manufacturability.

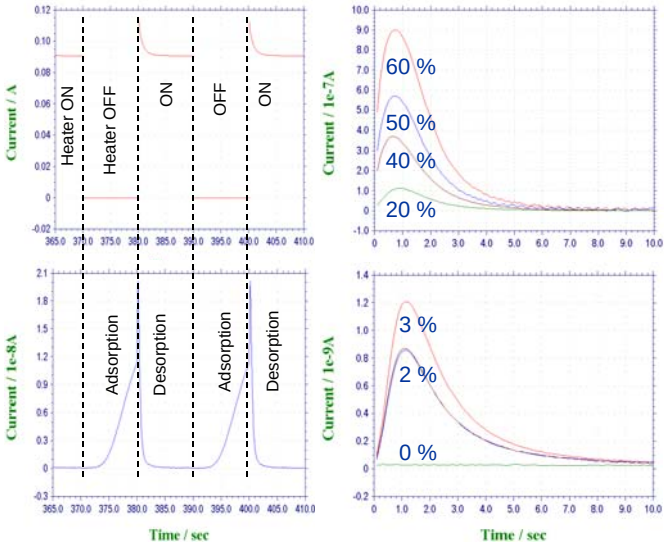
The technology is scaleable, supports multiple packaging options and is cost-competitive.

OPERATING MODES

Two operating modes are supported: "*passive*" mode (no heating), and "*t-pulse*" mode (periodic heating). In both cases, a constant voltage is applied to sensing electrode and the current or resistance is measured. A typical measurement profile in a *t-pulse* mode includes 2 cycles:

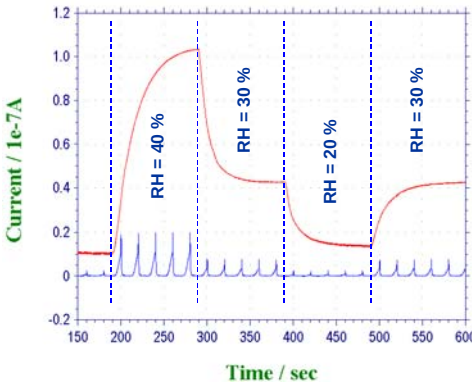
- adsorption cycle (heater off) to allow water molecules to adsorb onto the sensing element (2-100 s, depending on desired sensitivity).
- desorption cycle (heater on) to evaporate water molecules from the sensing element (150°C, 5-15 s).

During the desorption cycle a quick rise in current is observed. The desorption current peak yields a highly reproducible measurement for a given RH level and adsorption cycle duration.



T-pulse mode at 40% RH (10s pulses, 25°C)

Desorption peaks for different RH (25°C).



Typical sensor response to RH changes in passive (red) and T-pulse (blue) modes.

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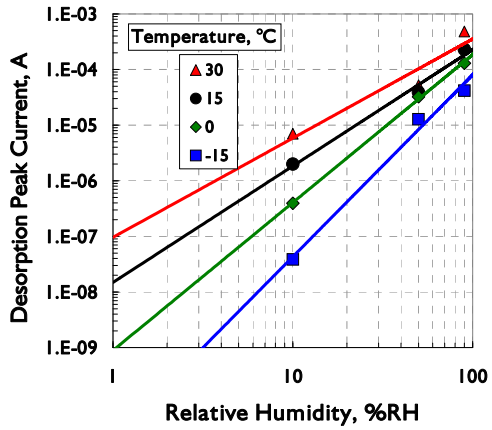
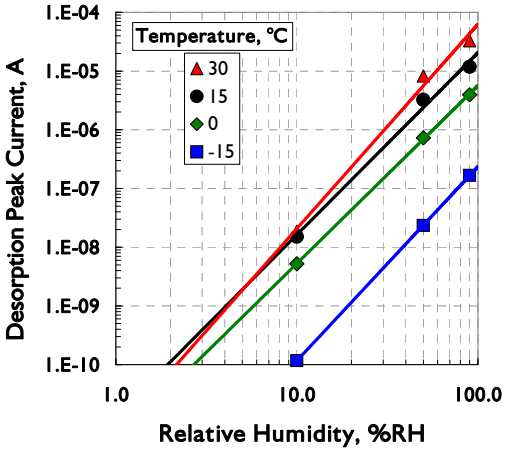


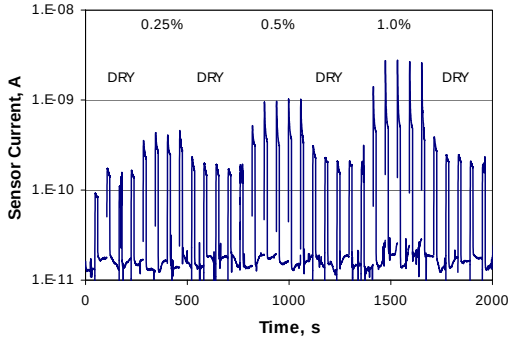
Non-modified sensors in t-pulse mode at 240 sec cycle.



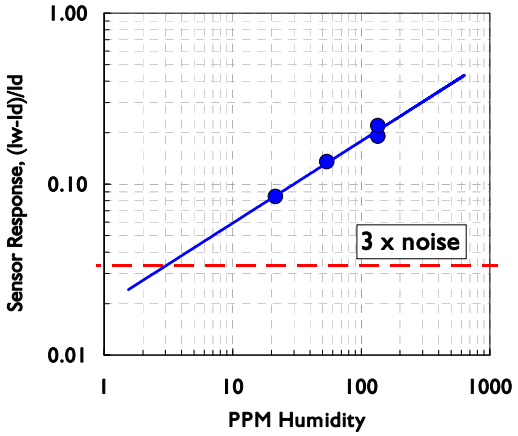
Non-modified sensors in t-pulse mode at 30 sec cycle.

NEXT GENERATION LOW PPM SENSORS

For the detection of low humidity levels , additional chemical modification of the sensing element is performed. Sensors modified in such fashion exhibited much stronger and faster response in comparison with unmodified sensors.



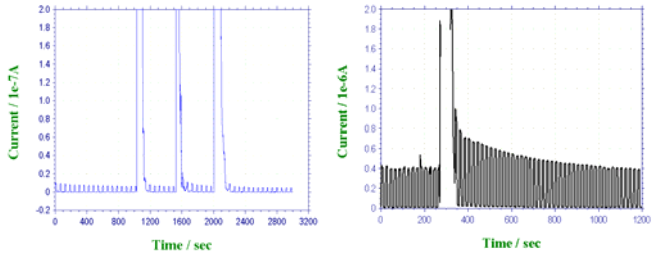
Response of modified sensor in t-pulse mode at 25°C



Modified sensor in t-pulse mode at 25°C.

REGENERATION CAPABILITIES

The sensors demonstrated robust recovery from wetting and contamination by a number of chemicals that could be burned out during the high temperature cycle. This procedure could be constantly enabled in the *t-pulse* mode, or could be applied periodically in a *passive* mode.



Sensor current recovery in t°-pulse mode after sprays of water (left) and antifreeze (right) were applied.

Many application opportunities exist for the featured humidity sensors. We are currently targeting applications that require low-cost, low-power, high sensitivity, fast response, reliable and robust humidity sensors that can operate in a variety of environmental conditions, have a broad temperature range and could be regenerated from contamination and wetting.

Joint development partnerships are being sought to further advance and qualify the featured humidity sensor technology for a wide range of applications. Areas of potential collaboration include specific application development, field-testing, instrument integration, and market introduction. *Synkera Technologies* strives to be customer oriented. If you have a special application you would like to discuss, or questions you would like answered please contact us at info@synkera.com.

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