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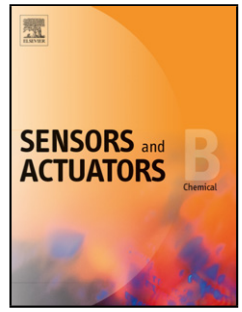

Title: Self-heating in pulsed mode for signal quality improvement: application to carbon nanostructures-based sensors

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Self-heating in pulsed mode for signal quality improvement: application to carbon nanostructures-based sensors

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Abstract.

Sensor signal instability and drift are still unresolved challenges in conductometric gas sensors. Here, the use of self-heating effect to operate a gas sensor in a pulsed temperature modulation mode (pulsed self-heating operation) is presented as an effective method to enhance signal stability and reduce consumption figures down to a few μW. The sensor operation temperature was pulsed periodically between two levels, obtaining two different sensing states from one single device driven with self-heating, i.e. free of heater. The signal differences between both operating points correlated well with gas concentrations and displayed no drift. This methodology is exemplified with a thorough study of the response of carbon nanofibers to humidity. Specifically, after analyzing the influence of the pulse characteristics (i.e. temperature variation, pulse period and pulse duty cycle) on the sensor performance, thumb rules to select suitable pulsing conditions are provided. The methodology is successfully extended to other target gases, such as NO_2 and NH_3. Finally, its implementation in a real-time sensing system with low computational requirements is demonstrated and discussed in detail.

Keywords: self-heating**,** low power consumption, high stability, pulsed sensing operation**,** conductometric gas sensor, nanomaterials.

Highlights:

- Pulsed self-heating operation is a simple and powerful methodology to improve the signal quality of a conductometric sensor.
- Pulsed self-heating operation reduces power consumption to the range of μW, without the need of incorporating heating elements.
- Sensor signal can be systematically improved by understanding the role of pulsing temperature, period and duty cycle, and then optimizing these parameters.
- For long term operation, the sensor response was found to be stable after 20 hours of continuous operation.