Pulsed heating enabled low-power gas detection with graphene-based sensors on a MEMS platform

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With the emergence of the Internet of Things (IoT) era, gas sensors need to be miniaturized in size and power consumption for integration into portable devices. Generally, both metal oxide semiconductor (MOS) and graphene-based gas sensors are activated by an external heating source for higher sensitivity, faster response, and full recovery. In this study, we used sensor platforms with microheaters (diameter 120 µm) embedded into Si membranes. An array of chemiresistive sensors were prepared based on chemical vapor deposited (CVD) graphene functionalized with atomic layer thick metal oxides through pulsed laser deposition (PLD) [1]. To improve the long-term stability and reduce power consumption, the sensors were operated in a pulsed-heating mode with only a 5–10% duty cycle. With different coatings and suitable operating temperatures (~200 °C), sensors showed promising responses to reducing and oxidizing gases such as NH_3, H_2S, O_3, and NO_2. Different stationary and pulsed heating modes were studied to evaluate the adsorption and desorption processes and establish optimal operating conditions for a reliable and selective detection of the gases (work in progress). This study suggests the potential of using pulse heating and machine learning for enhanced gas detection [2].

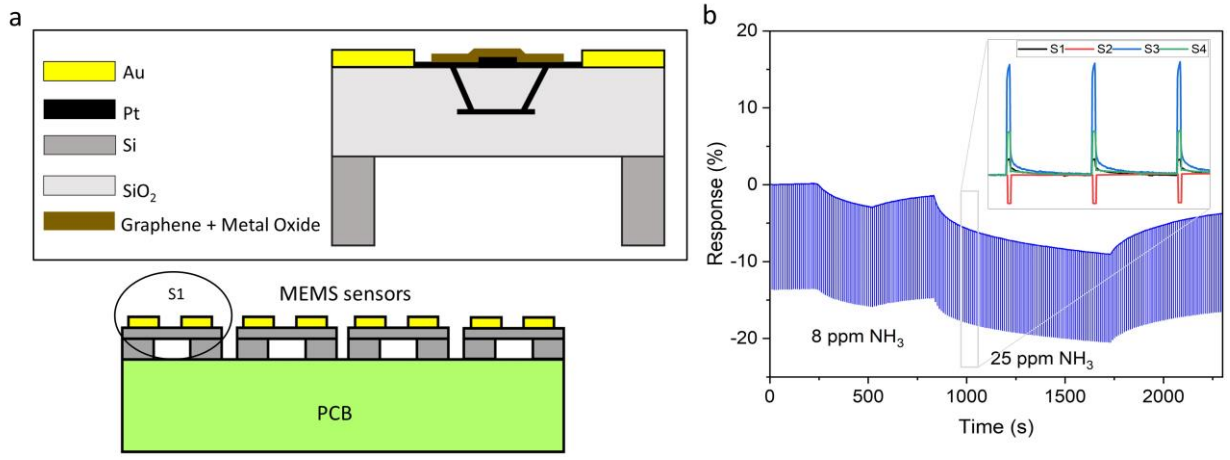

Fig.1 (a) The schematic of the prepared device (b) The gas sensing responses to NH_3. The inset compares the shape of the transient signal pattern of sensors during a single 500 ms (heating) + 9500 ms (cooling) cycle.

References

1. Kodu, M.; et al., *Appl. Phys. Lett.*, 109, 113108 (2016).

2. Lind, M.; et al., *Chemosensors*, 10, 68 (2022).