Ppt Level Detection of Acetone in Air atmosphere using Graphene Surface Acoustic Wave Gas Sensor

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With the development of modern urbanization, human beings have been struggling with numerous health issues and environmental problems. Due to these problems, the life of span of human beings has been quietly reduced in recent years [1–2]. To improve the life span and health of human beings, we need a device that can monitor their health in a real-time environment. The surface acoustic wave (SAW) sensor has received great attention owing to its superior enhanced thermal stability, lower phase noise compared to crystal resonators, high quality and superior temperature characteristics [3]. SAW resonator works on the surface phenomenon that makes them highly sensitive to external changes in the environment like temperature, gases and humidity etc. Therefore, any disturbance on the surface of the sensing layer (e.g., mass loading, electrical loading, elastic loading, etc.) leads to a significant effect on the propagation of the acoustic waves, which in turn leads to changes in frequency, phase, and amplitude. Hence, SAW sensors are highly attractive in the field of gas sensing applications.

Herein, we have fabricated a CVD graphene/SiO_2 SAW (G-SAW) with love wave for the effective detection of ppt-level acetone gas molecules under room temperature are shown in Fig.1 (a). Fig. 1(b) represents the 3D-printed gas chamber for gas sensing analysis. G-SAW showed an ultra-high sensitivity with a wide range of concentration towards the acetone gas molecules (800 ppt - 70 ppm) in the real-time atmosphere (Fig. 1(c) and (d)). The higher sensitivity of the G-SAW sensor can be attributed to the elastic and acoustic-electric effects. This work provides a potential strategy to diagnose diabetic stages in the human body.

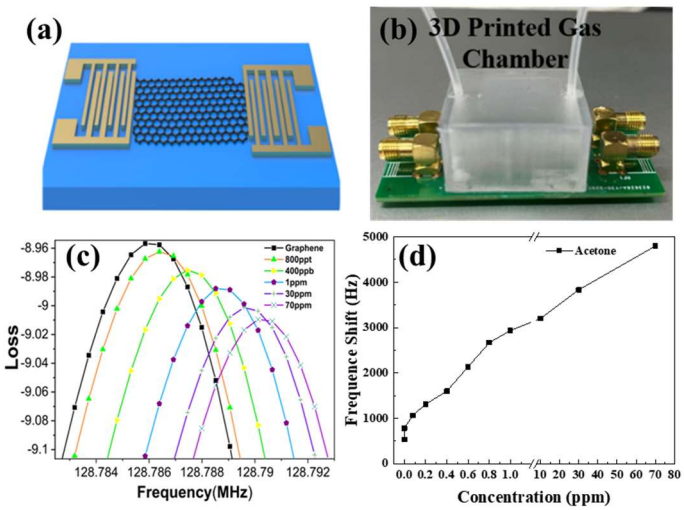

Fig.1 (a) Schematic diagram of SAW sensor with graphene. (b) 3D printed gas chamber with G-SAW device. (c) Loss spectra at different acetone gas concentrations. (d) Frequency shift response at different acetone concentrations.

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