Impact of the Dielectric Substrate on the Sensitivity of Multi-Layered Graphene-Based Gas Sensors

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Graphene provides the great potential to drastically lower the limit of detection (LOD) due to the large specific surface area and strong surface activity [1]. To further improve the sensitivity, the approaches mainly adopted by literature aim at modifying the sensing material. Here we present an alternative and extremely low-cost approach to tune the sensitivity. The sensor's sensitivity is altered simply by changing the deposition process of the dielectric substrate underneath the sensing layer. SiO_2 was grown in three different ways: thermal oxidation, low-pressure (LP) or plasma-enhanced chemical vapour deposition (PECVD). MLG prepared by chemical vapour deposition on a pre-patterned CMOS compatible Mo catalyst, was released on the underlying SiO_2. The sensors were tested upon NO_2 working at room temperature (RT) and relative humidity (RH) set at 50%. The sensor based on LPCVD SiO_2 results one order of magnitude more sensitive with respect to the other two devices. This work demonstrates experimentally feasibility of the concept only proved by DFT calculations [2].

References

[1] S. Yang, et al., Appl. Phys. Rev., 2017, 4(2), 021304.
[2] T. O. Wehling, et al., Appl. Phys. Lett., 2008, 93(20), 202110.

Figures

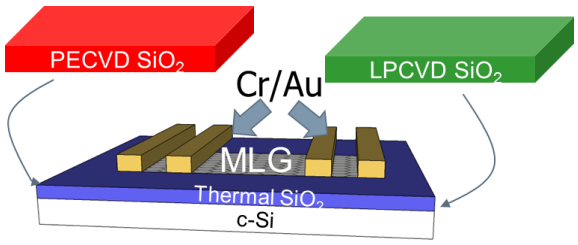

Figure 1: Figure 1: Schematic view of the evices. Between Si and multi-layered graphene, the SiO2 layer (90nm) is prepared by thermal oxidation (TH_OX), LPCVD or PECVD.

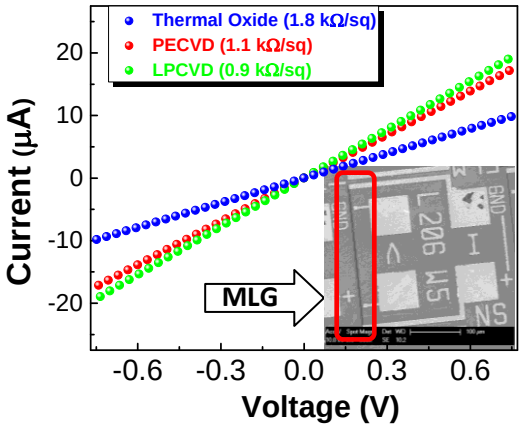

Figure 2: I-V curves of the three different devices and SEM image of the sensor propotype with the MLG bar (206 x 5 μm²) enclosed in the red box(inset).

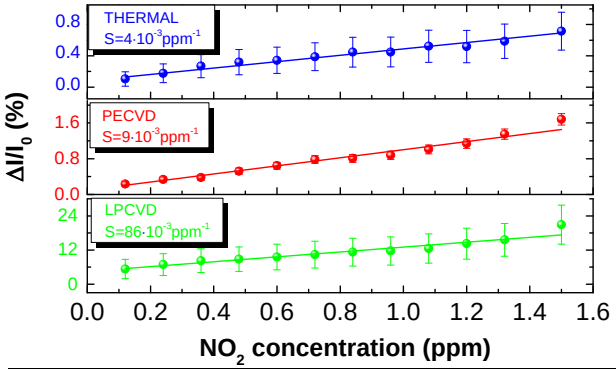

Figure 3: *Current percentage variations ($\Delta I/I_0$) as function of NO_2 concentration. I_0 represents the current value at the gas inlet for each gas injection. The slope of the calibration plots clearly shows a difference in the sensitivity attributed to the different depositions of SiO_2.*