

Real-time Conformational Switching of Graphene-Molecule van der Waals Bonding Complexes in Graphene Gas Sensors

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Electric field modulation of graphene-molecule van der Waals (vdW) complexes formed from adsorbed gases on graphene changes the graphene-gas molecule tunable charge transfer characteristics, bonding distance and carrier scattering,¹⁾ inducing a van der Waals bonding memory¹⁾ and conformational switching properties (predicted from simulations).²⁾

In this work, using an activated carbon molecular sieve on as-fabricated graphene channel (**Figure 1a**), controlled gas adsorption on the underlying graphene was induced. Alternate $\pm$ electric fields were applied to tune the gas adsorption induced graphene-molecule vdW complexes in various gas environments, and the real-time electric field induced conformational switching was observed via transfer characteristics measurements (**Figure 1b**). The switching was readily achieved in atmospheric air (**Figure 1c**), acetone/nitrogen mixtures, pure nitrogen, and dry air, consequently independent of the type of adsorbed gas molecules. Nevertheless, conformational switching was shown to be highly dependent on the ambient temperature and pressure as it was not observed at temperatures below ~ 110 °C (**Figure 1d**) or pressures below ~ 730 Torr (**Figure 1e**). Furthermore, switching was confirmed to be gas induced as it was not observed in vacuum even at 110 °C (**Figure 1f**). Our results show first experimental evidence of conformational switching in graphene gas sensors.

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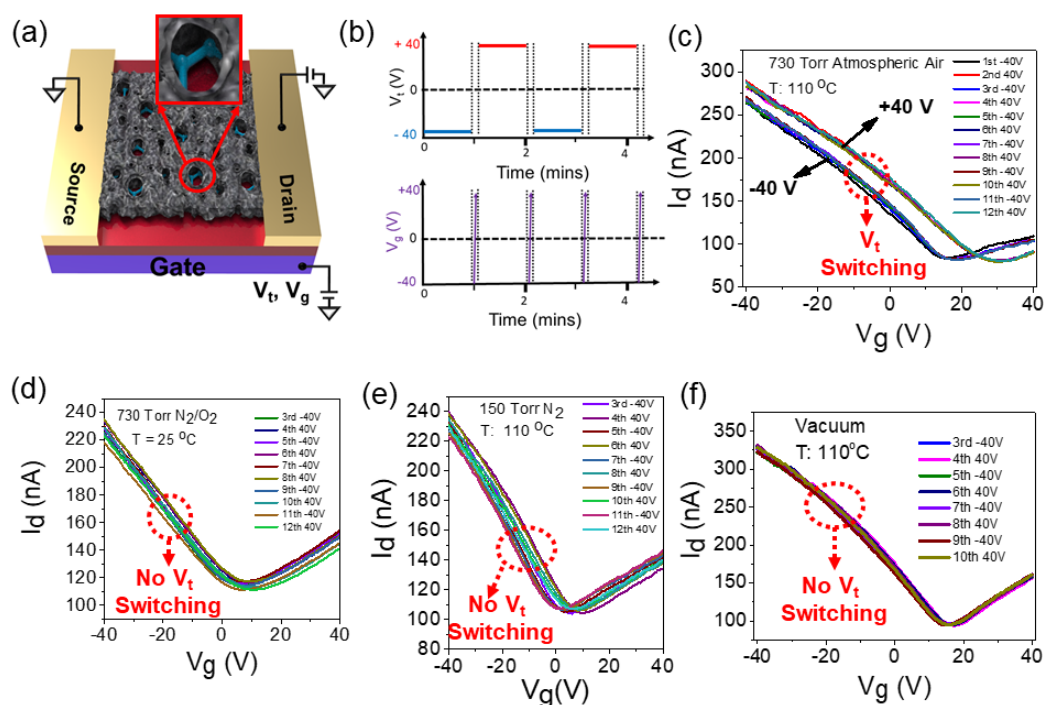


Fig.1: (a) Device schematic of the fabricated graphene sensor. (b) Experimental procedure for switching. (c) Tuning voltage (V_t) induced vdW switching observed in atmospheric air. vdW switching not observed at (d) low temperatures, T (e) low pressures, and (f) in vacuum.

Reference:

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