Suspended graphene membrane based device for biosensing applications

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Single layer graphene, owing to its extraordinary electronic and chemical properties, offers the potential application for the fabrication of an ultra-sensitive biosensor and/or chemisensor [1]. Freestanding graphene sheet have shown high charge carriers mobilities and large surface area for bio-or chemical interaction/interface as compared to similar sized substrate supported graphene sheet [2,3]. Recently reported micron size free standing graphene beam based two terminal biosensors have achieved sensitive multiplexed detection of lung cancer tumor markers [4]. Graphene channel based three terminal devices - graphene field effect transistor (GFET), even with the limitations of low I_{on}/I_{off} ratio, exhibits characteristic parameter; charge neutrality voltage (VCN), which is very sensitive to the surface charge interacting with graphene channel. The charge sensing ability of suspended graphene based FET (SGFET) can be explored for an ultra-sensitive biosensor for biomarkers and pathogens in their physiological conditions or in an environment.

In this poster, we shall be showing the device structure and electrical results of an array based three terminal freestanding graphene devices

Experimental work

The three terminal device, in which graphene is suspended over an array of micrometres scale cavities with top and back gate contacts, fabricated using conventional lithography. The micrometre-sized cavities are made either by drying etching (RIE) of sputtered SiO_2 layer or patterning of bulk polymer (SU8). Graphene-polymer film is then transferred on these prefabricated cavities and top contacts are later fabricated using conventional optical-lithography. Finally, the protecting layers are removed sequentially to realise the freestanding graphene over the cavity as the last steps.

Results and discussion

Fig. 1 shows the AFM images of 15 X 8 um^2 cavity with and without graphene, the device structure and drain-source characteristic current (Ids(A) Vs Vds(V)) modulated by the back gate (metal gate) voltage (Vgs(V), step of 0.1V).

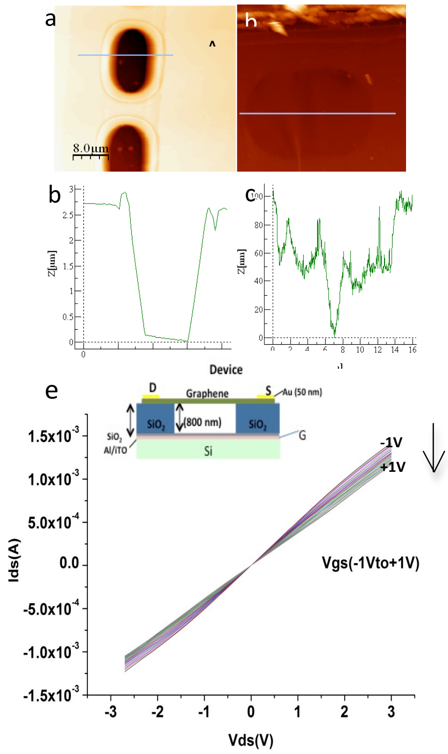

Fig. 1. AFM images of cavities; a) without b) with monolayer graphene, c) & d) line profile graph for a) and b) respectively and e) I-V characteristics (Inset: 2D-Device structure).

Conclusion

We fabricated and characterized the device for its potential use as ultra-sensitive biosensor. The end applications of this device shall be explored for the detection of DNA hybridisation and/or cardiac proteins, which is an element of future work on this device.

References

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