Gate tunable electrical transport in mechanically stacked CVD bilayer graphene field effect transistors at high bias

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Abstract

Graphene is an atomically thin layer of carbon atoms arranged naturally in a honey-comb lattice structure and has promising electronic properties [1]. One of the key properties of interest is its high mobility µ, resulting out of high carrier velocity v_c. However, high v_c accompanied by lack of a band gap causes non-saturating output characteristics in graphene field effect transistors (GFETs) which results in poor intrinsic amplification capability of the device. Here, we report GFETs fabricated using mechanically stacked bilayer chemical vapour deposited (CVD) graphene (Fig. 1). These GFETs demonstrate a back gate tunable maximum transconductance ($g_{m,max}$) and lower minimum output conductance ($g_{d,min}$) values as compared to monolayer GFETs (Fig. 2). This behaviour is observed mainly at high source-drain bias voltages. This cumulative behaviour culminates into an improved intrinsic voltage gain [2], which is a figure of merit often used to indicate the intrinsic amplification capacity of a GFET. This behaviour of our devices is attributed to higher induced carrier population in the stacked bilayer channel, which may introduce a number of scattering mechanisms; such as carrier-carrier scattering and carrier-phonon scattering, causing an enhanced current saturation tendency.

References

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[2] H. Pandey, S. Kataria, V. Passi, M. Iannazzo, E. Alarcon, and M. C. Lemme, "Improved voltage gain in mechanically stacked bilayer graphene field effect transistors," in *EUROSOI-ULIS 2016*, Vienna, Austria, 2016.

Figures

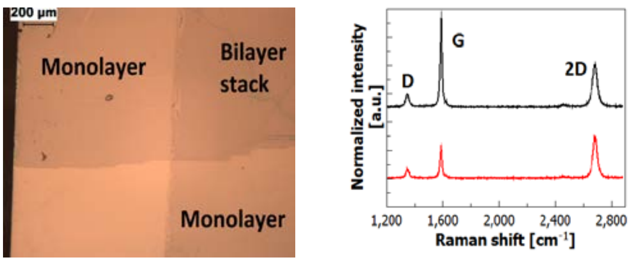

Figure 1: (a) Stacked CVD graphene bilayer on SiO_2/Si substrate and (b) its Raman signature (black curve), showing differences with respect to monolayer graphene (red curve).

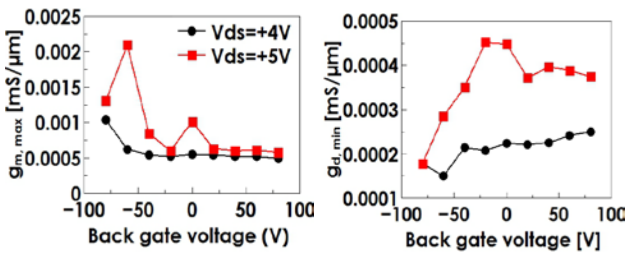

Figure 2: Back gate tunable behaviour of (a) maximum transconductance and (b) minimum output conductance at high bias in such a bilayer GFET.