Field effect mobility improvement in CVD graphene by using Local Metal Side-Gate

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Abstract:

The four most common architectures of graphene transistors are (i) back-gate transistor [1], (ii) top-gate transistor [2], (iii) suspended graphene transistor [3], and (iv) side-gate transistor [4]. The best mobility values are reported for suspended graphene transistors as the graphene channel is physically separated from gate-stack or substrate. However, side-gate transistors are a practical alternative.
In this work, the improvement of mobility of a graphene transistor is quantitatively studied (for the first time), when switching from back-gate to side-gate. Using experimental results and simulations, it has been shown that the hole mobility in a graphene channel improves at least 1.64 times (12,880 $cm^2/V.s$ for back-gate and 21,100 $cm^2/V.s$ for side-gate) by switching to side-gate operation in the same transistor.

References

[1] Mueller, T., Xia, F., & Avouris, P. (2010). Nature photonics, 4(5), 297.
[2] Liao, L., Bai, J., Qu, Y., Lin, Y. C., Li, Y., Huang, Y., & Duan, X. (2010). Proceedings of the national academy of sciences, 107(15), 6711-6715.
[3] Bolotin, K. I., Sikes, K. J., Jiang, Z., Klima, M., Fudenberg, G., Hone, J., Kim, P., & Stormer, H. L. (2008). Solid State Communications, 146(9-10), 351-355.
[4] Molitor, F., Güttinger, J., Stampfer, C., Graf, D., Ihn, T., & Ensslin, K. (2007). Physical Review B, 76(24), 245426.

Figures

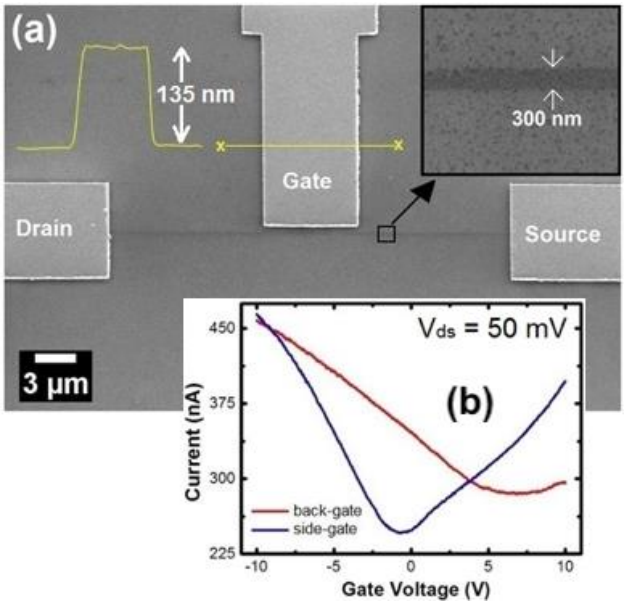

Figure 1: (a) SEM image of a fabricated side-gate graphene transistor. The yellow line represents data obtained by profilometry between the 'x' marks. Height of the profile is 135 nm. Inset: Magnified image of the graphene channel. (b) Back-gate and side-gate current vs gate voltage characteristics of the graphene transistor.

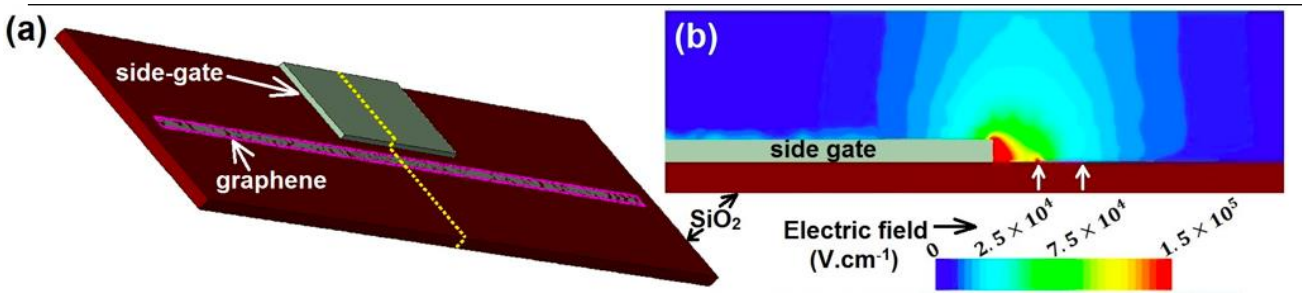

Figure 2: (a) Isometric view of the structure used to calculate the side-gate capacitance. (b) Distribution of absolute electric field through the yellow dotted line shown in (a). Position of the graphene sheet is marked using white arrows.