High Performance Field Effect Transistors with Atomically Precise Graphene Nanoribbons

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Bottom-up synthesized GNRs [1] have promising electronic properties for high performance field effect transistors (FETs) and ultra-low power devices, such as tunnelling FETs [2]. However, the short length and wide band gap of GNRs have prevented the fabrication of devices with the expected performance and switching behaviour [3,4]. Overcoming these challenges, we demonstrate high performance FETs by fabricating short channel (L_{ch}~20 nm) devices with a thin, high-κ gate dielectric and a 9-atom wide (0.95 nm) armchair GNR (9AGNR) as the channel material. The devices exhibit high on-current (I_{on} >1 μA at V_d = -1 V) and high I_{on}/I_{off} ~10^5 at room temperature. The moderate band gap of the 9AGNR and the high gate field near the contacts strongly increases tunnelling through the Schottky barriers (SBs), thus significantly enhancing the device performance.

References

[1] Cai, J. *et al*. Nature 466, 470–473 (2010)
[2] Zhao, P., *et al.* Nano Lett. 9, 684–688 (2009)
[3] Bennett, P. B. *et al.* Appl. Phys. Lett. 103, 253114 (2013)
[4] Gao, J. *et al.* ACS Nano 10, 4847–4856 (2016).

Figures

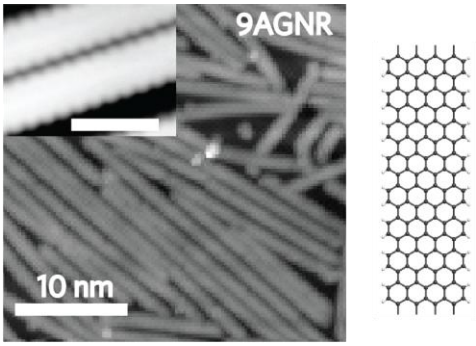

Figure 1: STM image of synthesized 9AGNR on Au. Inset: High resolution STM image of 9AGNR on Au with a scale bar of 1 nm.

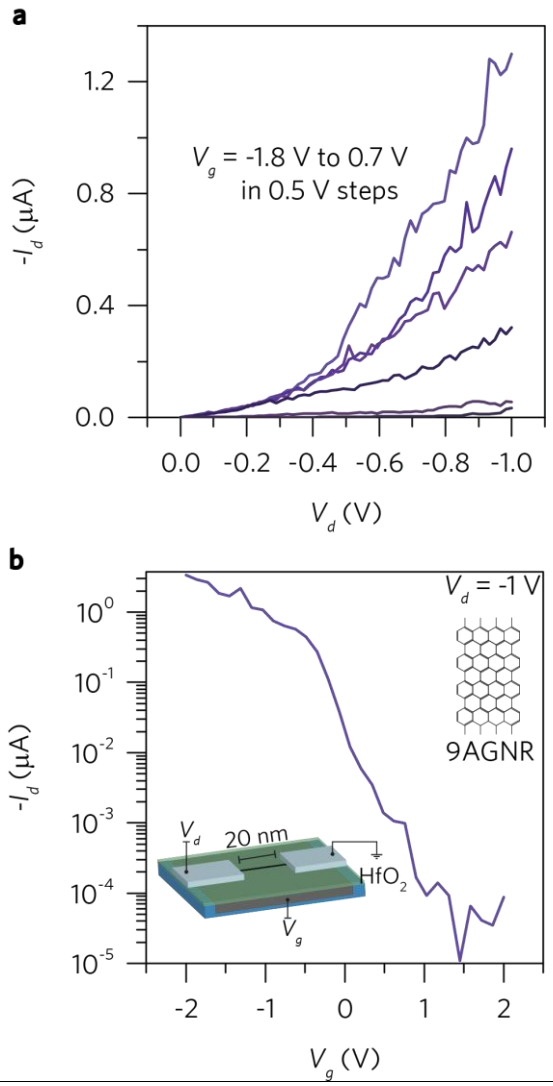

Figure 2: *I_d-V_d* (a) and *I_d-V_g (b) characteristics* of high performance 9AGNRFETs.