A Graphene Nanoribbon Memory Cell

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The past few years have witnessed a surge of interest in graphene, a recently isolated single sheet of graphite. Due to the absence of a bandgap in graphene and the formation of electron-hole puddles, graphene-based field-effect transistors cannot be turned off, thus limiting their application in electronic circuits. A strategy to increase the on/off ration relies upon patterning of graphene nanoribbons (GNRs), wherein quantum confinement opens a bandgap inversely proportional to the ribbon width.

Here, we demonstrate the operation of a digital memory cell consisting of a single GNR based on a nondestructive storage mechanism [1]. The devices are fabricated by patterning graphene into nanoribbons using V_2O_5 nanofibers as etching masks. A pronounced memory effect is observed under ambient conditions, which is attributed to charge traps in the vicinity of the GNRs. Gate voltage pulses of opposite polarity enable reliable switching between the distinct on- and off-states of the device for clock frequencies of up to 1 kHz and pulse durations as short as 500 ns for > 10^7 cycles. The durable and stable memory cell can be rendered nonvolatile upon exclusion of oxygen and humidity. Graphene nanoribbons thus emerge as promising components of highly integrated memory arrays.

References

[1] Eberhard Ulrich Stützel, Marko Burghard, Klaus Kern, Floriano Traversi, Fabrizio Nichele, Roman Sordan, *Small*, **6** (2010) 2822

Figures

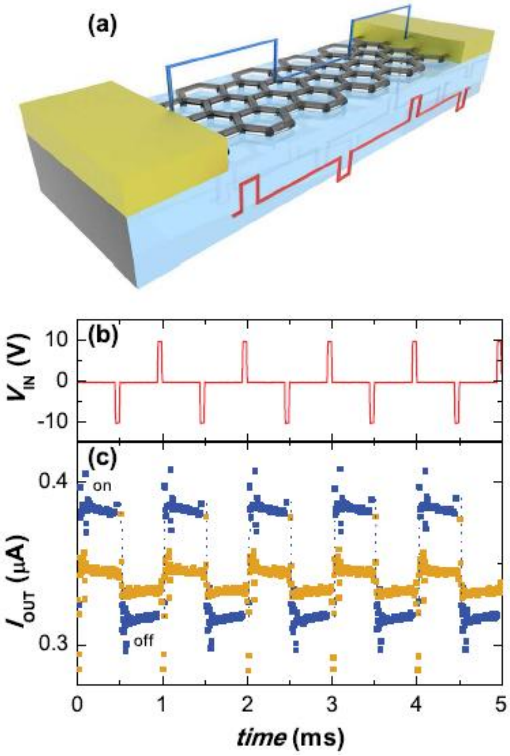

Figure 1: Digital waveforms gained from the GNR device under ambient conditions. (a): A schematic of the fabricated GNR memory device. The input trigger signal is the gate voltage (red) and the output signal is the drain current (blue). (b) Trigger signal at a frequency 1 kHz and a duty cycle of 10%. (c) Drain current at a drain bias of 1 V with an input signal frequency of 1 kHz. Two different duty cycles were used: 10 % (blue; pulse duration of 50 µs) and 0.1 % (gold; pulse duration of 500 ns).