Enhancing the current modulation in Graphene Transistors for Flexible Electronics

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Abstract

We describe results with four different approaches we have used to increase the on-off current ratio in graphene transistors. These approaches are all compatible with flexible electronics. In the first approach, we get reductions in the off-current and Dirac Voltage and increases in the mobility by coating the graphene with a fluoropolymer or other permanent dipole-containing material [1]. We present detailed experimental results, spectroscopy, as well as theoretical modelling to elucidate the underlying science [2].

In the second approach, we fabricated nanoribbons with graphene by electron beam lithography and etching. Nanoribbon with widths down to 20 nm have been realized. The on/off ratio is increased in nanoribbons at the expense of mobility. We show that this is related to the traps that are created at the edges of the nanoribbon. We present temperature dependent transport studies as well as dipole studies. The third approach involves the use of ion implantation of Si atoms to create controlled damage. Depending on the implant dose and energy (penetration), material properties are changed leading to higher on/off ratio's.

The final method we will describe is ongoing work that is especially suited to flexible electronics and will expectedly result in the highest on/off ratio's among all the methods we have used. It is expected that performance characteristics comparable to or exceeding that of other TMD transistors will be achieved in devices that are expected to be relatively stable.

References

[1] T.J. Ha *et al.*, ACS AMI vol 5, pp 16-20 (2013)
[2] B. Worley *et al*., J. Phys. Chem C. vol 120, p 12909 (2016).

Figures

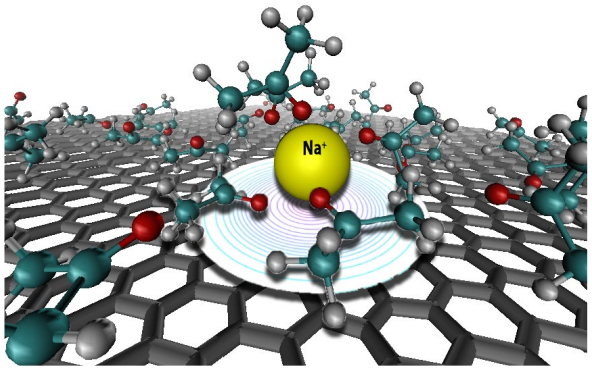

Figure 1: Dipolar molecules neutralizing the scattering potential of ions in graphene.

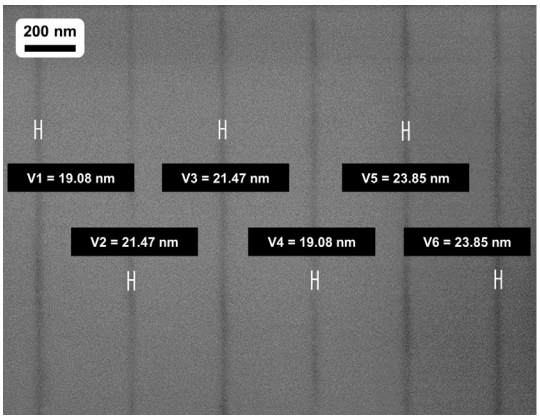

Figure 2: Electron micrograph of graphene nanoribbons of ~ 20 nm width.