Ink-jet Printed Graphene-Silicon Schottky Diodes

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Abstract

Integration of graphene (Gr) in silicon-based technology is of crucial importance for enabling the next generation electronics, photonics and sensors [1]. Although numerous works have reported devices based on Gr-Si junctions, the integration process relies on the use of high quality Gr produced by Chemical Vapour Deposition (CVD), making the fabrication steps expensive, time consuming and by limiting the large scale devices' reproducibility.

In this work we show that inkjet-printing enables simple and scalable integration of Gr into Si-technology [2]. We developed a simple fabrication procedure, based on the mechanical or chemical etching of the SiO_2 layer from a standard Si wafer, followed by the inkjet printing of water-based printable Gr inks [3] on the exposed area, leading to Schottky diodes with excellent rectifying behaviour and figures of merit, comparable to those produced with CVD graphene. We fully characterized the devices and applied several theoretical models achieving deep understanding of the underlying physics of the devices. We also investigated the optical response of the diodes by demonstrating a spatially selective photodetector.

Our results demonstrate that inkjet printing is a cost-effective and scalable method, which is also compatible with back-end-of-line fabrication processes for the integration of graphene in the modern Si-technology.

References

[1] Akinwande et al, Nature, 573, 507–518 (2019)
[2] Grillo et al, ACS Nano, 17, 2, 1533–1540 (2023)
[3] McManus et al, Nature Nano, 12, 343 (2017)

Figures

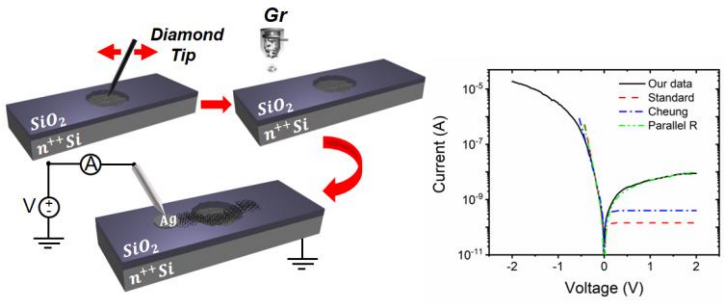

Figure 1: Schematic of the fabrication process and I-V characteristic of the printed Gr-Si diode