Scalable process of high quality graphene for integration into electronic circuits

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A reliable large-area fabrication process for high quality graphene is a key requirement for its integration into high market volume applications such as broadband image sensors and high-speed photodetectors.

By combining graphene with other two-dimensional (2D) materials, carrier mobility values far above 100 000 cm^2/Vs, at room temperature (RT), have been shown [1]. However, the device fabrication scheme used lacks scalability. By contrast, it is possible to obtain high quality large area single crystalline graphene by large scale CVD graphene growth [2]. The open questions are how to combine this high quality CVD graphene with a high quality scalable transfer method.

Here, we show the use of thin copper film catalysts deposited on single crystalline sapphire wafers, for the growth of high quality CVD graphene in combination with a large area dry transfer. This resulted in low hysteretic and low-doped devices (Fig.1), pointing at the importance of the CVD graphene synthesis method. Moreover, we developed a fabrication method for hetero-stacking 2D materials with commercial CVD graphene, assisted by a novel post process temperature treatment, which recovers the intrinsic quality of graphene after a detrimental wet transfer. Devices fabricated with commercially available CVD graphene by this method, reached mobility values above 20 000 cm^2/Vs (Fig.2).

These results pave the way to the fabrication of low-doped and high RT mobility devices on wafer scale, allowing further implementation of devices in a CMOS technology platform [3].

References

[1] F. Pizzocchero et al., Nature Comm. 7 (2016) 11894

[2] Y. Wang et al., RSC Adv. 8 (2018) 8800-8804

[3] S. Goossens et al., Nat Phot. 11 (2017) 366–371

Figures

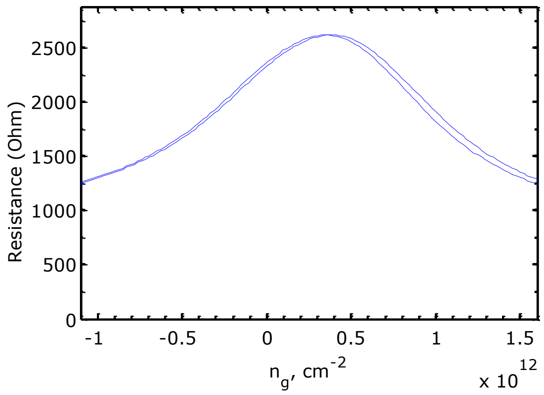

Figure 1: Graphene device on SiO_2, fabricated using thin Cu-film catalyst on single crystalline sapphire showing low hysteresis and low doping.

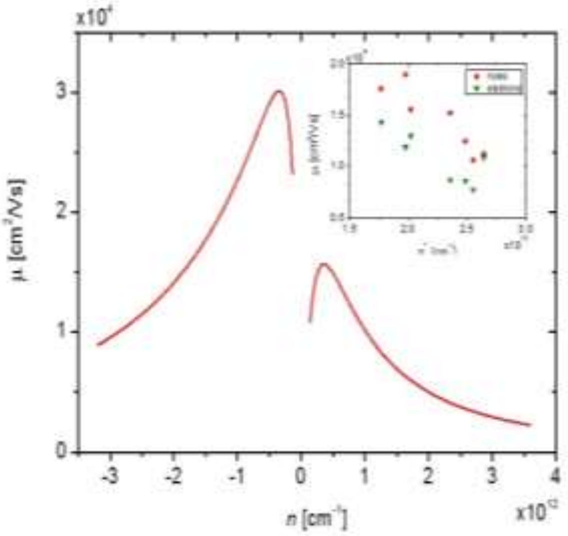

Figure 2: Room temperature field effect mobility of wet transferred CVD graphene encapsulated between hBN flakes and with thermal post-treatment. The inset shows correlation between mobility and residual doping *n** for CVD graphene on hBN for various samples