

Scalable process of high quality graphene for integration into electronic circuits.

Tymofiy Khodkov¹

S. Goossens¹, Yu Bi¹ and F.H.L. Koppens^{1,2}

¹ ICFO - The Institute of Photonic Sciences, Av. Carl Friedrich Gauss 3, 08860 Castelldefels, Spain.

² ICREA - Institució Catalana de Recerca i Estudis Avançats, 08010 Barcelona, Spain

tymofiy.khodkov@icfo.eu

The development of full wafer-scale integration processes is a “bridge” between lab fabrication techniques and industry production that should eventually bring 2-dimensional materials, such as graphene, to market-volume applications such as broadband image sensors and high speed photodetectors. However, to be fully established, this process requires to overcome several drawbacks, including minimizing doping inhomogeneity, hysteresis and the surface roughness. Moreover, high electron mobility is a necessary factor to get ultra-fast and sensitive devices.

Previously it has been demonstrated that the combination of graphene with other atomically flat materials leads to outstanding device performance where carrier mobility reaches values far above 100 000 cm²/Vs at room temperature (RT) [1,2].

Here we show potentially scalable fabrication methods for hetero-stacking 2D materials, like hexagonal boron nitride (hBN) and transition metal dichalcogenides (TMD), with CVD graphene for low-doped high mobility devices at RT. We developed a novel post-process temperature treatment to recover intrinsic quality of graphene after a detrimental wet transfer. The device mobility of commercially available, wet transferred CVD graphene reaches values above 20 000 cm²/Vs (Fig.1). Besides, the study involves integration of large area graphene onto chemically grown other 2D materials on insulating substrates. Making a clean interface between graphene and

other 2D material plays an important role for high-quality two-dimensional devices. We also propose one of the subsequent multi-stacking transfer method inside a vacuum chamber, which makes it possible to reduce surface contaminations and create 2D hetero-structures with flat and residual-free interfaces.

Reliable wafer-scale graphene transfer methods allows further implementation of devices in the CMOS technology platform[3]

References

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Figures

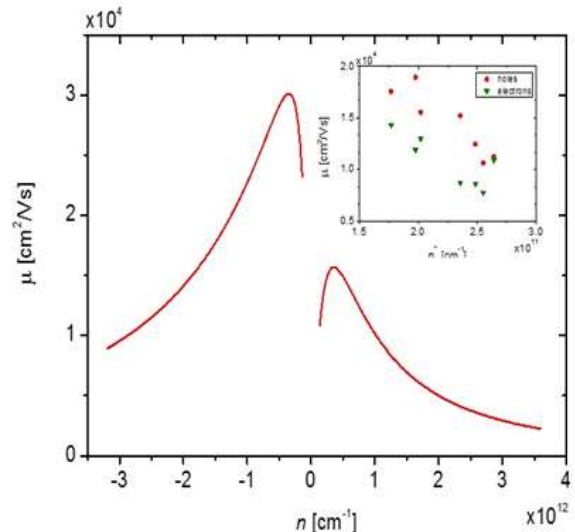


Figure 1: Room temperature field effect mobility of wet transferred CVD graphene with thermal post-treatment encapsulated between hBN flakes. The inset shows correlation between mobility and residual doping n^* for CVD graphene on hBN for various samples