Wafer-scale transfer of CVD graphene for flexible electronics

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Flexible electronics is expected to be the ubiquitous platform for the next-generation life science, environmental monitoring, display, and energy conversion applications. Outstanding multifunctional mechanical, thermal, electrical, and chemical properties of graphene combined with transparency and flexibility solidifies it as ideal for these applications. Although chemical vapor deposition (CVD) enables cost-effective fabrication of high-quality large-area graphene films, one critical bottleneck is an efficient and reproducible transfer of graphene to flexible substrates.

We explore and describe a direct transfer method of 6-inch monolayer CVD graphene onto transparent and flexible substrate based on direct vapor phase deposition of conformal parylene on an as-grown graphene/copper film. [1] The method is straightforward, scalable, cost-effective and reproducible. The transferred film shows high uniformity, lack of mechanical defects and sheet resistance for doped graphene as low as 18 ohm/sq and 96.5% transparency at 550 nm while withstanding high strain in bending. To underline that the introduced technique is capable of delivering graphene films for next-generation flexible applications we demonstrate a wearable capacitive controller, a heater, and a self-powered triboelectric sensor.

[1] Maria Kim, Ali Shah, Changfeng Li, Petri Mustonen, Jannatul Susoma, Farshid Manoocheri, Juha Riikonen and Harri Lipsanen, 2D Materials, **4**, 035004 (2017).