Going beyond copper: wafer-scale synthesis of graphene on sapphire

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The adoption of graphene in electronics, optoelectronics and photonics is hindered by the difficulty in obtaining high quality material on technologically-relevant substrates, over wafer-scale sizes and with metal contamination levels compatible with industrial requirements. To date, the direct growth of graphene on insulating substrates has proved to be challenging, usually requiring metal-catalysts or yielding defective graphene. In this work, we demonstrate a metal-free approach implemented in commercially available reactors to obtain high-quality monolayer graphene on c-plane sapphire substrates via chemical vapour deposition (CVD). Raman spectroscopy and electrical transport measurements reveal high quality graphene with mobilities consistently above 2000 cm²/Vs. We scale up the process to 4-inch and 6-inch wafer sizes and demonstrate that metal contamination levels are within the limits for back-end-of-line (BEOL) integration. The growth process introduced here establishes a method for the synthesis of wafer-scale graphene films on a technologically viable basis.

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