Synthesis of epitaxial graphene on SiC for graphene-based electronics

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Despite outstanding electronic properties of graphene such as high carrier mobility and ballistic transport at room temperature [1], wafer-scale synthesis of high-quality graphene still remains a major bottleneck for mass production of marketable graphene-based devices.
Within this framework, controlled synthesis of epitaxial graphene (EG) on silicon carbide (SiC) wafers [2], via the preferential sublimation of Si surface atoms at high temperatures (typically > 1500ºC), or, alternatively, catalytic growth by chemical vapour deposition (CVD) constitute the only realistic approaches for the commercial success of innovative graphene electronic devices.
Competitive advantage of EG on SiC for electronics include SiC intrinsic properties [3], i. e. wide bandgap, high-breakdown electric field, good thermal conductivity and high saturated electron drift velocity. SiC constitutes an ideal platform to fabricate high-voltage devices, microwave power field effect transistors (FETs) and integrated circuits (ICs) operating at high temperature. Remarkably, the so-called *graphitization* of SiC does not require subsequent transfer process, preventing e.g. metallic/non-metallic contamination. In other words, EG directly grown on SiC is a compatible process with standard complementary metal-oxide semiconductor (CMOS) technology.
In this contribution, we will summarize our findings on the synthesis of EG on SiC. Emphasis will be given to our advances for its subsequent processing, e.g. for the fabrication of back-gated graphene transistors. Offered strategies include a buried implanted layer on SiC, at controllable depth and avoiding severe surface lattice damage (Fig. 1); or using a thin semi-insulating SiC seed-layer, fabricated on top of doped wafers via homoepitaxial growth.

References

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Figures

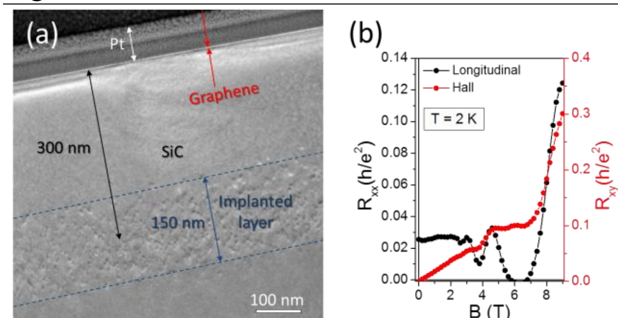

Figure 1: (a) Cross-sectional transmission electron microscopy image of an ion (nitrogen) implanted SiC substrate covered with an EG layer; (b) Longitudinal (R_{xx}) and Hall (R_{xy}) resistances as a function of the magnetic field at 2 K.