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Capturing the transition from 3C SiC(111) to graphene by XPS and STM in Ultra High Vacuum

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By using X-Ray Photoelectron Spectroscopy and Scanning Tunneling Microscopy we have been able to follow the time evolution of graphene layers obtained by annealing 3C SiC(111)/Si(111) crystals at different temperatures. Analysis of the atomic resolution images and of the Carbon signal provides a clear picture of the graphene formation. We have been able to visualise by STM the first steps of graphene formation on the surface of SiC finding the sequence of reconstructions which lead from the SiC(111) surface to graphene, caused by the Si sublimation. We followed by XPS the evolution of the graphene thickness at different temperatures as a function of the annealing time, finding a power growth law with exponent 0.5. We show that a kinetic model, based on a bottom-up growth mechanism, provides a full explanation to the evolution of the graphene thickness as a function of time, allowing to calculate the effective activation energy of the process and the energy barriers, in excellent agreement with previous theoretical results. Our study provides a complete and exhaustive picture of the Si out-diffusion from SiC, establishing the conditions for a perfect control of the graphene growth by SI sublimation.

References

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