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From above or from below? Determining how graphene layers form on SiC(0001)

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SiC decomposes when heated above 1200 C in vacuum. Silicon desorbs, while the carbon left behind can coalesce to form graphene. Growth of graphene on the SiC(0001) surface (“Si face”) and the SiC(000-1) (“C face”) is very different. On the Si face, graphene growth is epitaxial, while on the C face the growth is generally much less ordered. On the Si face, the observed epitaxy suggests that new graphene layers form under existing one, that is, at the SiC/graphene interface. The lack of epitaxy on the C face suggests that the growth mode on this surface might be different. To test this, we grew ultra-thin epitaxial SiC films (1 nm) on both SiC(0001) and SiC(000-1) via CVD using isotopically pure carbon-13. We then formed graphene via high-temperature thermal decomposition. We used medium energy ion scattering to determine where the carbon-13 was located within the graphene film. For both the Si face and C-face, we find that the carbon-13 is located predominantly in the outmost graphene layer, confirming that graphene grows “from the inside out” on both surfaces [1]. This work was performed in collaboration with Matt Copel and Ruud Tromp.

[1] Phys. Rev. Lett. 107, 166101 (2011)