X-RAY STANDING WAVE ANALYSIS OF EPITAXIAL GRAPHENE ON SiC(0001)

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The implementation of graphene into next-generation electronics will require production high-quality graphene at the wafer scale. One promising path to wafer-scale graphene is to produce epitaxial graphene (EG) via thermal decomposition of Si-terminated SiC (SiC(0001)). This method produces high-quality EG, but is accompanied by the formation of the so-called "buffer layer" at the interface which affects the electronic properties of the graphene. Despite numerous efforts to determine the nature of the buffer layer, a great deal of debate persists concerning its atomic and chemical structure. Here, we use the X-ray Standing Wave (XSW) technique to create a detailed chemically-sensitive description of the distributions of Si and C at the interface. This technique, which combines dynamical diffraction and X-ray Photoelectron Spectroscopy (XPS), is capable of locating coherent distributions of chemically distinct species above a single crystal surface. This allows for a more complete description of the interface than those offered by XPS or diffraction alone. Our analysis shows that the buffer layer, which is present in both UHV and furnace-grown EG/SiC(0001), contains no substantial silicon component, and is thus purely carbon. We identify two chemically distinct carbon species within the interface layer, each with a distinct location above the Si-terminated surface. We report the locations and distributions of the chemical species near the interface with sub-angstrom precision. While these results help to clarify long-standing uncertainties about the interfacial structure of graphene/SiC(0001), we also highlight the potential for XSW with XPS to become a valuable tool in the structural determination of more complex structures, such as functionalized, doped, and intercalated epitaxial graphene.