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Semiconducting graphene and its incommensurate SiC interface[1]

MATTHEW CONRAD, MEREDITH NEVIUS, FENG WANG, Georgia Tech, KATHERINE JINKINS, Univ Wisconsin , ARLENSI CELIS, Univ Paris-Sud, MAYA NAIR, ALESSANDRO COATI, AMINA TALEB-IBRAHIMI, SOLEIL, ANTONIO TEJEDA, Univ Paris-Sud, PAUL MICELI, Univ Missouri, EDWARD CONRAD, Georgia Tech — The development of a viable form of semiconducting graphene has been the goal since the onset of graphene research. Using improved growth techniques, we show that the first epitaxial graphene layer grown on SiC(0001) (the buffer layer) is semiconducting. With ARPES, we found that the buffer layer has a band gap > 0.5eV. At present, no existing theory explains the observed band structure. This is in part due to a corresponding lack of detailed structural studies of the buffer. Using SXRD, we show that the buffer layer is not the commensurate $(6\sqrt{3} \times 6\sqrt{3})R30^\circ$ structure assumed for the past four decades. Rather, it is tensile strained and interacts with a strongly modulated SiC interface layer. The buffer-interface layer pair is well ordered, yet incommensurate with bulk SiC. We also find that the buffer evolves during the growth process and reverts to a near commensurate phase with a large RMS roughness when a monolayer forms. These structural changes correspond with changes in the band structure that demonstrate the importance of the incommensurate phase in producing semiconducting graphene.

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Matthew Conrad
Georgia Inst of Tech

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