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Evidence for graphene growth by C cluster attachment ELENA LOGINOVA, NORMAN C. BARTELT, PETER J. FEIBELMAN, KEVIN F. MCCARTY, Sandia National Laboratories — Until now the detailed mechanisms of graphene growth have not been experimentally determined, owing to limitations of the available experimental techniques. We study the epitaxial growth of graphene on Ru(0001) measuring simultaneously the growth rate of individual graphene islands and the local, absolute concentration of vapor-deposited, mobile carbon adatoms. We have learned what controls the nucleation and growth rate of graphene, and what species transport carbon over the metal surface. We find that the growth rate is limited by C-atom attachment, not by C-atom diffusion, and that the absolute value of the supersaturation required for appreciable growth rates is comparable to that required to nucleate new islands. Thus, a large barrier must exist for monomers to attach to the graphene step edge. The growth rate as a function of supersaturation is highly nonlinear. Such behavior can be explained if carbon clusters must form as precursors to carbon attachment. As experiment and theory reveal, this could arise from strong bonding of individual monomers to the metal substrate. We will discuss a model that explains and provides insight into the molecular processes by which graphene grows. This research is supported by the Office of Basic Energy Sciences, Division of Materials Sciences, U. S. D. O. E. under Contract No. DE-AC04-94AL85000.

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