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Scanning Tunneling Microscopy Studies of Crystalline Hydrogenation of Graphene Grown on Cu(111)[1] STEVEN J. TJUNG, GRADY A. GAMBREL, The Ohio State University, SHAWNA M. HOLLEN, University of New Hampshire, JAY A. GUPTA, The Ohio State University — Because of the sensitivity of 2D material surfaces, chemical functionalization can be exploited to tune the electronic structure of these materials. For example, hydrogen bonding to carbon atoms in graphene tunes the material from a semi-metal to a wide-gap insulator. We developed a method for a reproducible epitaxial growth of graphene on Cu(111) in the ultra-high vacuum chamber of a scanning tunneling microscope (STM). We find that hydrogen atoms can be bonded to the graphene in a nanoscale region using a novel field-emission process, whereby physisorbed H_2 is cracked in situ using the STM tip. This method produced crystalline surfaces of hydrogen-terminated graphene with 4.2Å lattice, which has proven difficult to produce using conventional atomic beam methods which typically produced disordered hydrogenation. Additionally, this hydrogenation process is reversible and we are able to recover the pristine graphene by H desorption during STM imaging at a high bias. STM images after the dehydrogenation process showed the same atomic lattice and Moiré pattern as the pristine graphene, with the exception of additional point defects. STM spectra show the suppression of the Cu surface state on the hydrogenated graphene, but the opening of a wide-gap was not observed.

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Steven J. Tjung
The Ohio State University

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