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Controlling the electronic structure of graphene using surface-adsorbate interactions PIOTR MATYBA, ADRA CARR, CONG CHEN, MARGARET M. MURNANE, HENRY C. KAPTEYN, JILA, Boulder, CO, DAVID L. MILLER, MARK W. KELLER, NIST, Boulder, CO, GUOWEN PENG, MANOS MAVRIKAKIS, Univ. Wisconsin-Madison, STEFAN MATHIAS, Univ. of Kaiserslautern — Strong coupling with the substrate, i.e. C-Ni hybridization, causes that the π state maximum in graphene on Ni(111) is shifted to below the Fermi level, resulting in a band gap of 2.8 eV.[1, 2] The intercalation of noble metals to underneath graphene can reduce this band gap by decoupling graphene from the substrate.[3] Here we use angle-resolved x-ray photoemission spectroscopy and DFT calculations to explore the influence of Na adsorbate on the electronic structure of graphene on Ni(111).[1] We show that the carefully controlled electronic surface-adsorbate interactions reduce the band gap to 1.3 eV with no need of intercalation, since the strong graphene-substrate coupling is counterbalanced by the coupling to the adsorbate. Subsequent intercalation drastically changes the electronic structure, reducing the band gap to <180 meV, and decoupling graphene from the substrate. Our results demonstrate full band gap closing using an adsorbate for the first time, and suggest that surface-adsorbate interactions make it possible to control the band gap, either statically or dynamically, which is potentially useful for novel electronics. [1] P. Matyba et al., in submission (2013), [2] A. Gruneis et al., Physical Review B 77 (2008), [3] A. Varykhalov et al., Physical Review B 82 (2010).

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