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Electronic Structure of Clean and Adsorbate-Covered Bi_2Se_3 RICHARD HATCH, MARCO BIANCHI, TILO PLANKE, Department of Physics and Astronomy, Interdisciplinary Nanoscience Center, Aarhus University, JIANLI MI, BO BRUMMERSTEDT IVERSEN, Center for Materials Crystallography, Department of Chemistry, Interdisciplinary Nanoscience Center, Aarhus University, PHILIP HOFMANN, Department of Physics and Astronomy, Interdisciplinary Nanoscience Center, Aarhus University — The electronic structure of the topological insulator Bi_2Se_3 was probed using angle-resolved photoemission spectroscopy (ARPES). The electronic properties of clean and adsorbate-covered samples were studied for a combination of different bulk dopings and adsorbates. Due to contamination on the surface, the Dirac point of the topological surface states moves to higher binding energies, indicating an increasingly strong downward bending of the bands near the surface. This time-dependent band bending can be accelerated by intentionally exposing the surface to carbon monoxide, alkali atoms and other species. For a sufficiently strong band bending, new spectral features in the energy region of both the valence band and the conduction band are found. These changes are explained by a confinement of the states and the formation of quantum well states. This interpretation is supported by simple calculations of the band bending effects and by photon energy-dependent ARPES measurement that show how the band dispersion in the direction perpendicular to the surface is lost and non-dispersing, sharp states appear within the energy regions of the projected bulk bands. For a strong band bending, the conduction band quantum well states are strongly Rashba split.

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