Localization of electronic states in a semiconductor revealed by their response to the band bending potential

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Using angle-resolved photoelectron spectroscopy (ARPES), we study InAs(001) and InAs(110) surfaces having band bending induced by inclusion of Te atoms. Electronic bands related to two-dimensional electron gas (2DEG), as well as 3D conduction and valence bands, are investigated. All 2DEG subbands are described well with copies of a single lineshape similar to the usual InAs Kane **kp** band shape, with only the band-edge mass adjusted. We show that the band-edge mass parameter is correlated with the degree of the electron gas confinement. The 2DEG numerical description within the Schrödinger-Poisson scheme and the Thomas-Fermi approximation is also convergent with the experimental data. The valence bands energies closely follow the bending potential level at the very surface, showing that associated electronic states are localized on a scale of 1 nm. In contrast, the observed conduction band is insensitive to the bending potential, evidencing that the extent of states belonging to this band is of the order of at least 10^3 nm.

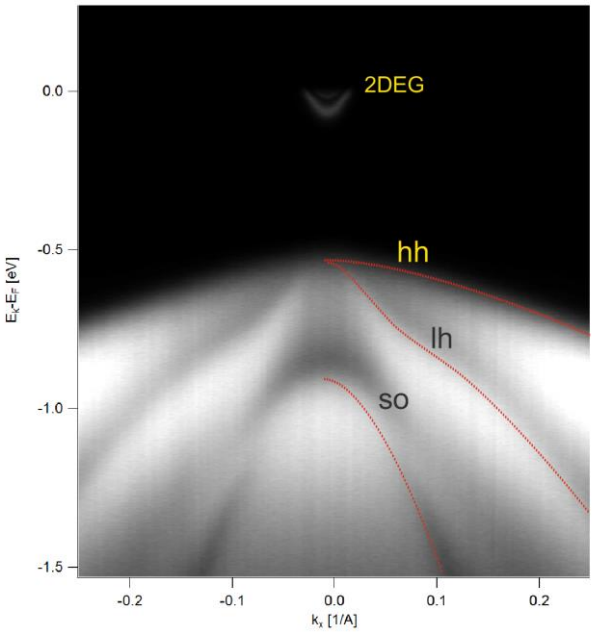

Fig. 1. ARPES spectrum acquired for InAs(110) surface showing 2DEG and valence bands