Study on structures and electronic states of sulfur-treated InAs(111) and InSb(001)surfaces.

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For InAs, InSb and their mixed crystal surfaces, the promising materials for optelectronic devices working in infrared region, reduction of the surface states is a problem which would be encountered in the device fabrication. In this study, surface structures, chemical states of surface atoms, and electronic states for sulfur-passivated InAs(111) and InSb(001) surfaces has been investigated thoroughly by using low-energy electron diffraction(LEED), Auger electron spectroscopy (AES), scanning tunneling microscopy(STM), photoemission and inverse photoemission spectroscopies (PES and IPES), and following results are obtained.

An InAs(111)A-(2x2)-S surface is found for the first time for sulfurized III-V compounds by an $(NH_4)_2S_x$-treatment and annealing although the structure of $(NH_4)_2S_x$-treated InAs(111)B surface is explained in the same fashion as used for the sulfur-treated GaAs(111)B surface so far. Unoccupied dangling bond states are decreased by the sulfur-treatment for the (111)A-(2x2)-S surface. A reliable structure model for the (2x2)-S surface is proposed by a kinematical calculation of the S 2s XPD patterns. The occupied band structures for the (2x2)-S surface are experimentally revealed by angle-resolved PES. For $(NH_4)_2S_x$-treated InSb(001) surface, a sulfide passivation layer as thick as 6-7 monolayers are formed as opposed to the other $(NH_4)_2S_x$-treated III-V compound surfaces where the sulfide layer is formed within a few atomic layer.

The results of the study for the sulfur-passivated InAs(111) and InSb(001) surface give a fundamental information for the fabrication of optelectronic devices and hetero-devices on (111) substrates.