論　文　内　容　の　要　旨

博士論文題目

Atomic and Electronic Structures of the Bi-adsorbed and In-adsorbed Si(110) Surfaces

（ビスマス及びインジウム吸着Si(110)表面の構造と電子状態の研究）

氏　　名

Ang, Artoni Kevin Roquero

（論文内容の要旨）

This thesis studies the electronic and atomic structures of the clean Si(110)16×2 surface, Bi-adsorbed Si(110) surfaces, and In-adsorbed Si(110) surfaces in detail.

The investigations of the electronic structure of the clean Si(110)16×2 surface revealed the nature of the previously ambiguous electronic states that are located in the projected bulk bands. By observing the effects of changes in the surface structures on the dispersions of these states, it was experimentally concluded that these states were 16×2 derived surface resonances that originate from backbond states between Si atoms underneath this 16×2 reconstruction.

For Bi-induced Si(110) surfaces, detailed structural investigations produced a new, more detailed, phase diagram of the adsorption of Bi on the Si(110) surface. Two new surface reconstructions were revealed, and structural models were proposed for these pseudo-1D surfaces. These models can be adapted to explain similar reconstructions on other Si(110) surfaces. Angle resolved photoelectron spectroscopy (ARPES) experiments revealed semiconducting surfaces and several non-dispersing surface states derived from Bi-Si backbonds for these Bi-induced reconstructions.

Furthermore, the inversion layer of the Si(110) surface was investigated by adsorbing indium atoms on the surface to induce strong band bending. The growth and reconstructions of In atoms on the Si(110) surface were investigated and the electronic structures of these In/Si(110) surfaces were revealed by ARPES. These surfaces were found to be semiconducting, with several non-dispersing surface states and an upward band. However, the band bending was not strong enough to produce the desired quantized hole subbands.

氏　名	Ang, Artoni Kevin Roquero

（論文審査結果の要旨）

This thesis studies the electronic and atomic structures of the clean Si(110)16×2 surface, Bi-adsorbed Si(110) surfaces, and In-adsorbed Si(110) surfaces in detail.

In this thesis, the investigations of the electronic structure of the clean Si(110)16×2 surface revealed the nature of the previously ambiguous electronic states that are located in the projected bulk bands. By observing the effects of changes in the surface structures (by metal-induced reconstructions) on the dispersions of these states, it was experimentally concluded that these states were 16×2 derived surface resonances that originate from backbond states between Si atoms underneath this 16×2 reconstruction.

For Bi-induced Si(110) surfaces, detailed structural investigations done in this thesis produced a new, more detailed phase diagram of the adsorption of Bi on the Si(110) surface. Two new surface reconstructions were revealed, and structural models were proposed for these pseudo-1D surfaces. Angle resolved photoelectron spectroscopy (ARPES) experiments revealed semiconducting surfaces and several non-dispersing surface states derived from Bi-Si backbonds for these Bi-induced reconstructions.

As a possible FET material, the inversion layer of the Si(110) surface was investigated by adsorbing indium atoms on the surface to induce strong upward band bending. The growth and reconstructions of In atoms on the Si(110) surface were investigated and the electronic structures of these In/Si(110) surfaces were revealed by ARPES. These surfaces were found to be semiconducting, with the 1 monolayer (ML) Si(110)1×1-In surface having several non-dispersing surface states and the strongest upward band bending among the surfaces investigated in this thesis. However, the band bending observed on the surface was not strong enough to induce the quantization required to produce hole subbands (HSB).

As described above, this thesis has clarified the electronic structure of the Si(110) 16×2 surface, and, for the first time, performed a comprehensive investigation of the surface and electronic structures of Bi- and In-adsorbed Si(110) surfaces. Because this knowledge is fundamentally important to the basic surface science and semiconductor physics, the committee agreed that this thesis is worth as a PhD thesis for a Doctor of Science.