

Abstract

This thesis reports investigations of the electronic properties of a semiconductor surface (silicon carbide), a reactive metal/semiconductor interface (manganese/silicon) and a non-reactive metal/semiconductor interface (aluminum-magnesium alloy/silicon).

The (2×1) reconstruction of the 6H-SiC(0001) surface has been obtained by cleaving the sample along the $\langle 0001 \rangle$ direction. This reconstruction has not been observed up to now for this compound, and has been compared with those of similar elemental semiconductors of the fourth group of the periodic table. This comparison has been carried out by making use of photoemission spectroscopy, analyzing the core level shifts of both Si 2p and C 1s core levels in terms of charge transfer between atoms of both elements and in different chemical environments. From this comparison, a difference between the reconstruction on the Si-terminated and the C-terminated surface was established, due to the ionic nature of the Si-C bond.

The growth of manganese films on Si(111) in the 1-5 ML thickness range has been studied by means of LEED, STM and photoemission spectroscopy. By the complementary use of these surface science techniques, two different phases have been observed for two thickness regimes (<1 ML and >1 ML), which exhibit a different electronic character. The two reconstructions, the (1×1) -phase and the $(\sqrt{3} \times \sqrt{3})R30^\circ$ -phase, are due to silicide formation, as observed in core level spectroscopy. The growth proceeds via island formation in the monolayer regime, while the thicker films show flat layers interrupted by deep holes. On the basis of STM investigations, this growth mode has been attributed to strain due to lattice mismatch between the substrate and the silicide.

Co-deposition of Al and Mg onto a Si(111) substrate at low temperature (100K) resulted in the formation of thin alloy films. By varying the relative content of both elements, the thin films exhibited different electronic properties, manifested by the observation of quantum well states and a surface state. The resulting shift in binding energy of both quantum well states and surface state has been interpreted in terms of the virtual crystal approximation model where the main effect of the alloying process is attributed to the change of electron density of the system. For this system, the variation of photoemission intensity as a function of photon energy has been also investigated and explained in terms of collective excitations.