ABSTRACT

Part of this thesis is concerned with the preparation and characterization of well ordered graphite samples with large surface areas in form of thin overlayers. Graphite is of widespread interest in science and technology and given the lack of large single crystals, the development of overlayer samples is of considerable interest. The overlayers have been characterized with scanning tunnelling microscopy (STM) and photoemission. The layers have been prepared, *in situ* or *ex situ*, by heating different SiC crystals to temperatures up to 2000°C. The samples turn out to be of high crystalline quality giving better resolved photoemission spectra than previously reported for graphite. Details are resolved regarding the intricate band structure near the Fermi level and quite narrow emission lines are observed also for other valence electron states. This is of interest because narrow lines are the key for sensitive observation of energy shifts associated with changes in the environment such as by ad- or absorption.

The usefulness of graphite overlayer samples as substrates is illustrated in a study of binding energy shifts in graphite valence states upon K deposition. Three different graphite states are investigated showing almost uniform energy shifts upon deposition, indicating that the rigid band model gives a good description of the adsorption system. There has previously been no confirmation of the model by direct spectroscopic observation of the states close to the corners of the Brillouin zone, which are responsible for the semimetal character of graphite and involved in the charge transfer upon adsorption or intercalation. The graphite overlayers are also used to monitor the formation of alkali metal graphite intercalation compounds. By K or Rb deposition we have been able, according to angle-resolved photoemission data, to form the stage 1 intercalation compounds, C_8K and C_8Rb.

In another part of the present work, the surface systems obtained by deposition of Na or K on HOPG (highly oriented pyrolytic graphite) are found to realize simple metal quantum wells. Due to the particular band structure of graphite the alkali metal valence electrons are confined to the adsorbed film which serves as an almost ideal quantum well. It is found possible to grow well ordered multiple layers of Na or K on graphite. STM has been used to image Na islands, showing decaying standing waves originating from the occupied quantum well states (QWS) within the islands. For low coverage, potassium on graphite is a model system for alkali on semimetal and has been studied extensively at surface coverages in the monolayer range. In the present work, the initial growth is investigated for K, Rb or Cs evaporated on HOPG with novel information obtained for filled and empty valence states.

Keywords: Photoemission, STM, quantum well states, alkali metal adsorption, alkali metal graphite intercalation compounds, thin films, graphite, SiC, alkali metal.