# Electrochemical formation of n-GaAs/Ag contacts.

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Metal/semiconductor interfaces of the Schottky-barrier type are frequently used in integrated circuits, in light detectors and as solar cells. The main parameter characterizing the junction is the barrier height $\Phi_B$. Comparative studies, performed in the past upon the characteristics of n-GaAs/Au[(1)] and n-GaAs/Cu[(2)] barriers, formed either by electrochemical reduction of the metal ion or by vacuum deposition revealed the barrier height was strongly dependent on the chemical composition of the semiconductor/metal interface. In these measurements, the composition of the interface was controlled mainly by means of the potential at which the barriers were formed, as this potential controlled the kinetics of the deposition reaction as well as the composition of the semiconductor surface.

Besides by the potential, the composition of the semiconductor surface can also be varied by means of the electrolyte solution. In this work, a study was performed on the electrochemical formation of n-GaAs/Ag junctions in solutions with different pH and the influence of the electrolyte composition upon the properties of electrochemically formed Schottky barriers was investigated. Ag was chosen as the metal, as this allowed us to deposit the metal in solutions covering a large pH range.

The electrochemical measurements were performed on (100) GaAs electrodes in aqueous solutions containing 5mM Ag(I) ions (pH =1, 2.7, 6, 8 and 14). Depending upon the pH of the solution, different complexing agents were used.

The mechanism and the kinetics of the electroreduction process were studied by means of rotating disk and cyclic voltammetry. From the measurements it followed that, dependent upon the pH and the complexing agent, in some solutions the Ag(I) ion was reduced by conduction band electrons and in other solutions by hole injection into the valence band. This is explained on basis of the respective relative positions of the semiconductor and the redox energy levels in the different solutions.

Deposition experiments were performed in the different electrolyte solutions at various deposition potentials $V_D$. The amount of metal formed was determined coulometrically. In all solutions, except at pH=1 in which the Ag(I) ion was not complexed, interfaces with good adhesion properties were obtained. The Schottky barrier characteristics of the formed junctions however depended upon the electrolyte solution. At pH 1 the barrier height appeared to be independent on the deposition potential, and $\Phi_B$ increased in time after deposition (so-called aging effect). In all other solutions $\Phi_B$ was potential dependent and no aging was observed. Further, the value of the barrier height was dependent on pH, the largest values were found in the intermediate pH range. The results are interpreted in terms of a different surface composition of the semiconductor in the different solutions.

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References:

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