

An application of the secondary-ion photoeffect to the analyses of a structure semiconductor-dielectric

A. G. Rokakh, A.A. Serdobintsev, M.D. Matasov, V.A. Alexandrov, S.B. Venig, I.Yu. Stetsura, M.I. Shishkin and I.A. Kornev
Saratov State University, Russia

Effect of an additional illumination on the yield of secondary ions that discovered and preliminary studied some of authors mentioned was called secondary-ion photoeffect (SIPE). There are two kinds of this effect: normal and anomalous. The first realises in decrease of the secondary ion yield under illumination. The second increases such yield. The physical reason for the normal SIPE is connected with the compensation of secondary ions by electrons induced with ions outputting from a target to vacuum (compensating mechanism). In the case of anomalous SIPE the sufficient role play peculiarities of band structure in heterophase semiconductor. In our case polycrystalline semiconductor CdS(0,9)-PbS(0,1) consists of two phases: wide-gap phase with a composition near to CdS and narrow-gap phase (limited solid solution of CdS in PbS). Electron-hole pairs generated in the preliminating wide-gap phase and diffused to narrow-gap one where they recombine with creation of the excessive energy to enlight the secondary-ion output (recombination mechanism). Often there exist a concurention of two mechanisms and one of them preliminates. If additional light passes through optical filters, it was shown that normalous SIPE takes place at short-wave illumination a localization of wich is often connected with luminescence. In such a way a control of SIPE type is possible.

The results achieved on the model substance CdS-PbS are broadening on a more wider circle of substances: amorphous SiO and crystalline GaAs.

The aim of the present report is an aplication of results achieved to semiconductor or semiconductor-dielectric layer structures, namely SiO-AlGaAs-GaAs. Usual mass-spectrometric analyses of this structure was added by the SIPE analyse. White light was interrupted in two minutes. Duration of illumination was equal to the pause. Comparison of two investigation shows more distinctly space localization of ion output in the second case.

The measuring described is added by the investigation on an electron microscope in the regime of secondary electrons and cathodoluminescence. Measurements are fulfilled on Ar⁺ primary ions. Results obtained are connected with anomalous SIPE and positive secondary ions. A dependence of the secondary ion output on the character of connection with the earth is also investigated. A possibility of creation a transistor or phototransistor like structure with ion output is discussed.

Biography

A. G. Rokakh was graduated from Saratov State University in 1957 (physical department) and continued his work as a scientific researcher and a teacher. He is a Professor of the Nano- and Biotechnology department of the Saratov N.G. Chernyshevsky State University. He has above 350 publications in various fields. He was a member of the desk board of the international journal Physics Express and a nominator of "Prof. A.G. Rokakh Award" for the best paper of this journal in semiconductor physics; the Full Member of the American Nano Society.

rokakhag@mail.ru