Annals of the Academy of Romanian Scientists
Series on Science and Technology of Information
ISBN 2066-8562 Vol. **5**, Number **1/2012**

COMPUTATIONAL APPROACH TO DARK CURRENT SPECTROSCOPY IN CCD AS COMPLEX SYSTEMS. PART III*. DEFINITION AND USE OF A NEW PARAMETER CHARACTERIZING THE DEPLETION DARK CURRENT IN SEMICONDUCTORS

I. TUNARU[1], **R. WIDENHORN**[2], **E. BODEGOM**[2], **D. IORDACHE**[3]

Rezumat. *Studiul efectuat a evidenţiat faptul că frecvent rezultatele experimentale privind vitezelor de generare ale principalelor capcane adânci nu corespund valorilor prezise de aproximaţia „clasică" (presupunând egalitatea secţiunilor eficace: $\sigma_n = \sigma_p$ de captură a electronilor liberi şi – respectiv – golurilor) a modelului riguros cuantic al lui Shockley-Read-Hall (SRH). Pentru a îmbunătăţi precizia descrierii curenţilor de întuneric de golire, lucrarea de faţă a introdus un nou parametru „gradul de polarizare a secţiunilor eficace de captură a electronilor liberi, respectiv golurilor". În afara capacităţii sale de a furniza evaluări mai exacte ale curenţilor de întuneric din semiconductori, noul parametru reprezintă un instrument util pentru: a) analiza unor „anomalii" ale valorilor vitezelor de generare, b) atribuirea capcanelor cu nivele adânci pentru fiecare pixel CCD, pornind de la dependenţa de temperatură a curenţilor de întuneric din dispozitivele CCD.*

Abstract. *The accomplished study pointed out that frequently the experimentally observed generation rates of the main deep-level traps do not correspond to the values predicted by the classical approximation (assuming equal capture cross-sections $\sigma_n = \sigma_p$ of the free electrons and holes, respectively) of the Shockley-Read-Hall (SRH) rigorous quantum expression. In order to improve the accuracy of the depletion dark current description, this work introduced the new parameter "polarization degree of the capture cross-sections of free electrons and holes, respectively". Besides its ability to provide considerably more accurate evaluations of the depletion dark current in semiconductors, this new parameter represents a useful tool for: a) the analysis of some "anomalies" of the generation rate values, b) the assignment of deep-level traps for each CCD pixel, starting from the experimental data concerning the temperature dependence of the dark current in CCDs.*

Keywords: Charge-Coupled Devices, Dark Current, Capture cross-sections of free electrons and holes, Deep-level traps

1. Introduction

As it is well-known, the temperature dependence of the depletion dark current $De_{dep}^{-}(T)$ emitted in a semiconductor [with the intrinsic Fermi level E_i the

[1]Ph.D. student, Physics Department, University "Politehnica" of Bucharest, Romania.
[2]Professor, Portland State University, Oregon, USA.
[3]Professor, Ph.D., Physics Department, University "Politehnica" of Bucharest, Romania, Honorary member of Academy of Romanian Scientists.
*This paper represents the continuation (3rd part) of the works indicated by references [16].