Annals of the Academy of Romanian Scientists
Series on Science and Technology of Information
ISSN 2066 - 8562 Volume **3**, Number **2**/**2010**

STUDY OF THE NUMERICAL MODELING OF THE TEMPERATURE DEPENDENCE OF THE DARK CURRENT IN CHARGE COUPLED DEVICES (CCD)

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Abstract. *As it is well known, the classical works of the Dark Current Spectroscopy method allow - using some not too accurate theoretical relations, but huge numbers of dark current values for thousands of pixels - the evaluation of a reduced number of basic impurities parameters. Unlike these works, this paper tries to obtain – by means of some better approximations of the Shockley-Read-Hall (SRH) model - more information about the studied impurities, as well as the study of the compatibility of the used theoretical model SRH relative to the experimental data. In this manner, both the compatibility SRH model with the studied experimental data was checked up, as well as the values of some additional physical parameters of the impurified semiconductor (the logarithms of the pre-exponential factors lnDiff, lnDep, the effective value of the energy gap Eg) and of the separate capture cross-sections* σ_n, σ_h *of the free electrons, and holes, respectively, by the studied deep-level contaminants, were evaluated.*

Keywords: Dark Current Spectroscopy, Charge Coupled Devices chips, Dark Current, Shockley-Read-Hall model, Deep-level impurities, Capture Cross-Sections of Free electrons and holes

1. Introduction

As it is known (but not always checked up, by means of some specific compatibility criteria), the dark current in CCDs is described by the quantum theoretical model of Shockley-Read-Hall (SRH). It results that:

a) the dark current in CCDs in described by a huge number (unlimited, apparently) of (independent) uniqueness parameters, i.e. the studied CCDs are COMPLEX SYSTEMS,

b) this imposes the use of some APPROXIMATE RELATIONS (as the Arrhenius' one or the relations used by the classical works of the Dark Current Spectroscopy),

c) the values of the physical parameters obtained by means of these approximate relations depend on the specific features of each pixel, hence they are EFFECTIVE VALUES corresponding to some EFFECTIVE PARAMETERS, as: (i) the activation energy E_a from the Arrhenius' relation, (ii) the effective energy gap E_g intervening in the approximate relations, etc.

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