A new approach to a solar cell problem

Bronislaw Swistacz
Wroclaw University of Technology
Wyb. Wyspianskiego 27
Wroclaw, Poland

***Abstract-* In this paper a new concept for a space charge transport through a solid placed between the two electrodes is presented. The effect of the light on the electric field distribution and on the shape of current – voltage characteristic is determined. For a space charge distribution some new singular solutions are obtained. In this paper it is found that the system can act as a blocking diode.**

Keywords: double injection, space charge, trapping levels.

I. INTRODUCTION

One of the fundamental problems of a macroscopic theory of electric conduction is to find the total concentration of charge carriers in a solid placed between the two electrodes. In this paper, we will assume that the divergence of the electric field distribution will be defined by the total concentration of carriers. Also, we will suppose that the contact processes have an influence on the shape of the electric field distribution, which corresponds to a current – voltage characteristic.

The purpose of this work is to find a shape of a current-voltage characteristic $J(V)$ of the metal – solid – metal system.

2. THE MODEL

In this paper, for an orbital electron in the given atom, we will assume that the total energy (the sum of the positive kinetic energy and the negative potential energy of the electric field of the positive nucleus) is negative and that the zero reference level is at a finite distance from the nucleus. In the case of an isolated atom the total energy of an orbital electron is negative for any distance from the nucleus. When an orbital electron absorbs a portion of the kinetic energy of a photon or a phonon, the total energy of the electron increases. The inverse case is when an orbital electron can lose a portion of the total energy. This is caused by the Coulomb force interaction between the orbital electron and the positive nucleus. Let us take into account the two valence electrons of an isolated atom. When this atom is packed into a solid, these electrons can occupy the higher energy state. Next, when a portion of the kinetic energy is given to the two valence electrons, these electrons can become free. The two empty energy states (which are left by the electrons) represent the two holes. Between the zero and valence levels many energy states (the trapping states) are available for the holes and for the electrons. When an orbital electron absorbs a photon, this electron can pass from the valence level to the zero level via trapping levels. The inverse case is when an orbital electron can pass from the higher trapping level to the lower trapping level and an energy portion is emitted Analogously, we are known as the allowed transitions for the trapped holes. Such the allowed electron – hole transitions are called carrier generation – recombination processes. When an external electric field supplies the different kinetic energy to the two adjacent atoms the trapped electron can pass from trap to trap in the given trapping level. When the external electric field is applied the electron can pass from the cathode into a solid. Moreover, this electron can become free. Similarly, the hole injection occurs when the valence electron can pass from the bulk into the anode and the valence state is empty. When the external electric field gives a portion of kinetic energy to the valence electron of an adjacent atom, this electron can pass from the atom to the given atom and can fill the empty state on the valence level. The metal-solid-metal system will be represented by a planar capacitor system (Fig.1). With these above assumptions we can find the electric field distribution $E(x)$ and a current-voltage characteristics $J(V)$, here, J is the current density and V is the applied voltage. In order to find these functions, we have to define the boundary functions describing the mechanisms of carrier injection from the anode and the cathode into the bulk [1-7].

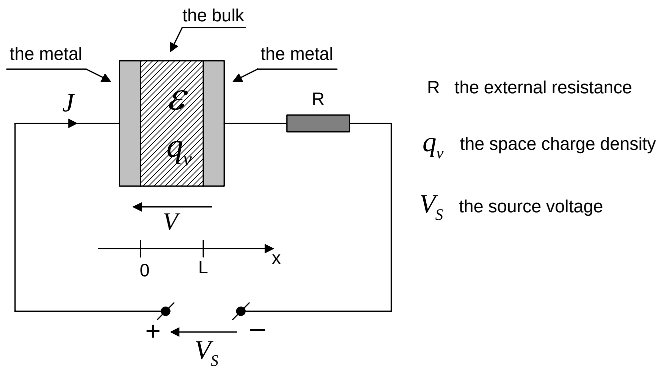

Fig.1 A planar capacitor is connected with an external resistance and a voltage source. Here, (+ -) denote the terminals of a voltage source.

3. DISCUSSION and CONCLUSIONS

When carrier generation processes are dominant, the electric field intensity satisfies a homogenous equation. Upon these conditions there exist two singular particular solutions as well as the general integral. Additionally, when the boundary functions are strongly increasing, we ascertain that there exists a set of values of applied voltage V in which the current density is not defined. This property denotes that the whole system acts as a solar cell, Also, we see that the $J(V)$ curve is strongly increasing and there can be $J(V) \equiv 0$. Therefore, the system acts as a perfect blocking diode and a voltage stabilizer. Also, this mathematical property corresponds to a solar cell.

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