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THE IMPEDANCE SPECTROSCOPY OF HYBRID STRUCTURES BASED ON CuIn₃Se₅ PHOTOABSORBER

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The preparation of CuIn₃Se₅ photoabsorber layers by using the pulsed laser deposition (PLD) and high vacuum evaporation (HVE) techniques was studied and the electrical properties of prepared layers were investigated with the method of impedance spectroscopy (IS). Raman spectroscopy, XRD and EDS were used for the studies of the morphology and phase composition [1].

The main issue in this thesis is the analysis of the IS results. The analysis used common method of electrical circuit analysis that was complemented with additional aspects. Besides the modeling of the entire frequency range with a single set of circuit parameters, the circuit modeling was accomplished with the modeling in the sliding mode where the narrow range of frequency (about 1 decade of frequencies) was used to find parameters of the circuit, allowing the finding of the dependences of parameters on frequency.

For the analysis of the content of the CPE elements of the modeling circuit there were proposed additional equations, that able the analysis of the problem with the use of methods of mathematical analysis and allow the test of the results with the data obtained by the experimental *I-V* measurements. It was shown that while applying special conditions to the parameters that can be concluded from the mathematical analysis, there can be observed a good match between calculations and experiment in some instances. The analysis proposed in the presentation is a simplified case. For the analysis of the general situation the appropriate equations are reported.

The IS measurements and calculations showed that both type of films (PLD and HVE) have a majority carriers concentration in the range of $1 \times 10^{15} - 1 \times 10^{16} \text{ cm}^{-3}$ and the mobility of majority carriers in the HVE deposited CuIn₃Se₅ films has the value in the order of 0.5 cm²/Vs. Proposed method of IS calculation can be applied to determine of main electro-physical parameters of deposited CuIn₃Se₅ layers. This gives a possibility of using this technique for the preparation of photo-absorber layers with predictable properties appropriate for the solar cell applications.

References

1. K. Laes, S. Bereznev, R. Land, A. Tverjanovich, O. Volobujeva, R. Traksmaa, T. Raadik, A. Öpik, The impedance spectroscopy of CuIn₃Se₅ photoabsorber films prepared by high vacuum evaporation technique. *Energy Procedia*, accepted for publication.