Opponent review of the thesis of Artem Musiienko „Photo-Hall effect spectroscopy and laser-induced transient currents in CdTe-based semiconductor radiation detectors“.

Theme of thesis of Artem Musiienko „Photo-Hall effect spectroscopy and laser-induced transient currents in CdTe-based semiconductor radiation detectors“ is interesting and actual because semiconducting materials CdTe, CdZnTe and CdMnTe have a huge application potential in spectroscopic room temperature radiation detection due to its properties. Such detectors can be used in medical applications, homeland security and for monitoring of nuclear facilities. However, the final device quality is influenced by many parameters. One crucial fact is the polarization of the detector caused by high radiation fluxes which negatively affects the use of such devices. The polarization occurs by capturing the photogenerated holes at the deep levels inside the semiconductor. This is reason why the study of deep levels in these materials is such important.

The goals of this thesis were: i) reintroduce Photo-Hall effect spectroscopy (PHES) and its modification as PHES with dual-wavelength to study deep levels; ii) the detailed analysis and understanding of negative photoconductivity; iii) developing a procedure enabling the detector characterization of laser-induced transient current technique.

This is a very complex issue, but on the other hand, the dissertant has a great advantage in working with a team that achieves very good results when studying CdTe-based detectors.

The experimental methods used in the dissertation represent a complex set of methods that have enabled the achievement of a range of unique results that a dissertant has interpreted using proposed models. Here I would pick up the comprehensive analysis of negative differential photoconductivity by means of Shockley-Reed-Hall simulation for p-type CdMnTe.

The work is written clearly, well logically structured and graphically nicely done. It is divided into seven chapters. The meaning of the work is clearly explained in the introduction to the thesis. In the theoretical part (chapter 2) are presented the basic equations describing the carrier transport, Photo-Hall deep level detection concept, Shocley-Read-Hall carrier generation-recombination, Metal-Semiconductor contacts and detector polarization and laser induced current waveforms. The third chapter describes the used measuring techniques and samples. The focus of work is in chapters 4, 5 and 6, where all obtained results are presented

and discussed. Results of Photo-Hall spectroscopy in n-type CdTe based detoctor and their interpretation are described in the fourth chapter. The same subject for the p-type CdMnTe is contained in chapter fifth. Characterization of polarizing semiconductor radiation detector by laser-induced transient current is presented in chapter sixth. All obtained results are summarized in short conclusions.

I have a few comments and queries to work:

1. “The Boltzmann equation is valid under assumption... no memory effects, i.e. no dependence on initial condition terms.” Is it valid in your relatively wide gap materials with deep levels in the middle of gap?
2. Can you explain the cause of the photoconduction hysteresis for the CdZnTe n-type sample?
3. What is the degree of potential non-uniformity to observe negative differential photoconductivity in the n-type detectors?
4. For better reader orientation, it would be better to compare the alphabetical list of abbreviations.
5. Fig. 2.1 model No 2 $h\nu = E_{t2} - E_V$

Thesis of Artem Musiienko „Photo-Hall effect spectroscopy and laser-induced transient currents in CdTe-based semiconductor radiation detectors“meets the demands placed on it and shows the author's ability to develop independent scientific work. I recommend the thesis for the defense.

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