Title: Photo-Hall effect spectroscopy and laser-induced transient currents in CdTe-based semiconductor radiation detectors
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Abstract:
Cadmium Telluride, Cadmium Zinc Telluride, and Cadmium Manganese Telluride are important semiconductors with applications in radiation detection, solar cells, and electro-optic modulators. Their electrical and optical properties are principally controlled by defects forming energy levels within the bandgap. Such defects create recombination and trapping centers capturing photo-created carriers and depreciating the performance of the detector. Simultaneously, the changed occupancy of levels leads to the charging of detector's bulk, which results in the screening of applied bias and the loss of detector's sensitivity. Detailed knowledge of crystal defect structure is thus necessary for the predictable detector work and also for the possibility to reduce the structural defects concentration.

This thesis reports on the investigation of deep energy levels in CdTe-based high resistivity and detector-grade materials by photo-Hall effect spectroscopy. The existing approach is also extended by dual-wavelength and enhanced monochromatic excitations. Experimental results are completed by numerical simulations based on the Shockley-Read-Hall model.

A method is presented for the determination of the carriers' drift mobility, lifetime, electric field distribution, and the dynamics of space charge in polarizing semiconductor radiation detectors. The procedure stems from the laser-induced transient current measurements done at steady-state and pulsed biasing and at variable temperature.

Keywords: CdTe, CdZnTe, CdMnTe, photo-Hall effect spectroscopy, transient-current-technique, Shockley–Read–Hall model simulations, deep levels, semiconductors, insulators, radiation detectors.