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Streszczenie rozprawy doktorskiej

Temat pracy: **„Hardware protection against laser impulses using materials with a complex structure"**

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Abstract

Hardware protection against laser impulses is a crucial aspect of the laser technology development. Recent advancements in military, scientific and commercial laser fields pose new requirements on the protective materials.

In this thesis heat transfer process between a laser beam and a solid body has been studied. A special consideration has been given to (i) ultra-fast high power laser-matter interaction and (ii) a continuous work laser and target interaction. Both aspects have been examined in order to propose concepts of thermal protection systems featuring materials with a complex structure.

A review of state of the art knowledge has been performed with the special attention given to laser technology advancements. Crucial work parameters such as output power, pulse shape and pulse duration have been reported. Military and scientific fields have been described. A present state of the knowledge on laser-matter interaction and resulting effects has been reported.

The analytical approach has been described in details and numerical simulation methods have been defined. Assumptions on mechanism of energy absorption, model of plasma-laser beam interaction and laser pulse shape have been presented.

In the context of the ultra-fast high power laser-matter interaction, a comparative analysis of the classical heat conduction equation and Cattaneo-Vernotte equation has been done. Heat waves collision simulation has been carried out. Potentially relevant effects in the context of the laser protection systems have been identified. The energy balance check was performed for each presented study.

In the part concerning continuous work lasers, a comparative analysis of various concepts of the hardware protection against laser has been carried out. Selected phenomena have been *employed* as protective mechanisms. Throughout the numerical investigation, performance of each proposal has been quantified.

Directions of the future work in areas of the non-Fourier effects and protection against high power lasers have been proposed.