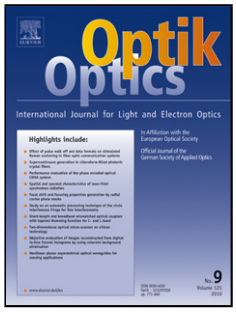

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Modeling of temperature and thermal-stress of silicon irradiated by a long pulsed laser and its damage evaluation

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Abstract:

In this paper, temperature and thermal-stress of silicon irradiated by a long pulsed laser are modeled and its damage evaluation is presented. Physical model is established based on the classical heat transfer and thermal-elasticity theory, integral transform method is used to solve the governing equations and analytical solutions of temperature and thermal-stress are obtained. Effects of radial locations, axial depths and laser spot radius on the temperature and thermal-stress are studied. Results show that, the surface temperature of the silicon material is the highest, and with the increase of depth, temperature gradually decreased; the maximum value of the three components of thermal-stress are all compressive stress, and the maximum value is located on the surface of the silicon; with the increase of depth, the thermal-stress value is gradually reduced; the damage of the long pulsed laser with a pulse width of 1ms to silicon material is mainly the melting damage.

Keywords: Thermal tress; Long pulsed laser; Laser damage; Analytical solutions

1 Introduction

In recent years, long pulsed laser heating has become a research hotspot in the