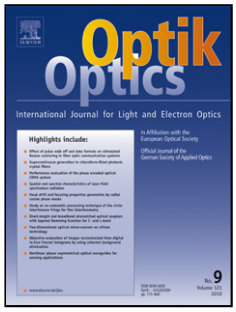

Title: Closed-form solutions for thermal stress in solid material induced by long pulsed laser with influence of atmospheric thermal blooming

Author: Guibo Chen Juan Bi

PII: S0030-4026(16)31594-7
DOI: http://dx.doi.org/doi:10.1016/j.ijleo.2016.12.044
Reference: IJLEO 58674

To appear in:

Received date: 26-10-2016
Accepted date: 12-12-2016

Please cite this article as: Guibo Chen, Juan Bi, Closed-form solutions for thermal stress in solid material induced by long pulsed laser with influence of atmospheric thermal blooming, Optik - International Journal for Light and Electron Optics http://dx.doi.org/10.1016/j.ijleo.2016.12.044

Closed-form solutions for thermal stress in solid material induced by long pulsed laser with influence of atmospheric thermal blooming

Guibo Chen Juan Bi*

(School of Science, Changchun University of Science and Technology,

Changchun 130022, P R China)

*Corresponding author

E-mail: custcb@126.com

Abstract:

In this paper, thermal stress of material irradiated by a distorted long pulsed laser considering the influence of atmospheric thermal blooming is modeled. By using analytical expression of laser intensity with atmospheric thermal blooming, axisymmetric heat transfer and thermal elasticity model of distorted long pulsed laser irradiating material is established. Integral transform method is used to solve the governing equation and closed-form solutions of thermal stress are obtained. We studied the effects of laser pulse width, laser propagation distance and intensity of undistorted laser beam on the thermal stress distributions of the material. Modeling results show that, the pulse width, the laser propagation distance in the atmosphere and the undistorted laser intensity have a significant effect on the thermal blooming, and then affects the thermal stress distribution of the material. The greater the pulse width of the laser, the larger the maximum value of the compressive stress. The smaller the propagation distance of the laser in the atmosphere, the larger the maximum value of the compressive stress. And the greater the laser peak power density, the larger the maximum value of the compressive stress.

Keywords: Thermal stress; Long pulsed laser; Thermal blooming; Closed-form solutions