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Study of temperature distribution in a metallic nanograting based on a Kerr nonlinear material irradiated by a nanosecond pulsed laser

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Abstract

In this article, we investigate the temperature distribution in a one-dimensional metallic nanograting heated by a nanosecond Gaussian pulse laser using the finite element method. It is assumed that the nanograting slits are filled with a Kerr-type nonlinear material. The results indicate a strong dependency of the system's temperature distribution on the incident laser fluence. Also, the temperature distributions are completely different for linear and nonlinear regimes at high laser fluences around the pulse peak and after that. Indeed, exciting the nonlinear optical Kerr effect, especially at high laser fluences, leads to a change in the temperature response of the nonlinear regime compared to the linear one. Moreover, depending on the applied laser wavelength, there is a possibility of increasing or decreasing the temperature compared to the linear case. On the other hand, one can not enhance the laser fluence to any amount, as this may raise the temperature even higher than the melting point of the materials. Therefore, as the strong laser pulses are applied, temperature investigations should be conducted to prevent excessive heating and damage to the system.

Keywords: temperature distribution, nanograting, pulsed laser, fluence, linear and nonlinear regimes

For full article, refer to the Persian section