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Molecular-dynamics study of multi-pulsed ultrafast laser interaction with copper

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A B S T R A C T

Ultrafast laser has an undeniable advantage in laser processing due to its extremely small pulse width and high peak energy. While the interaction of ultrafast laser and solid materials is an extremely non-equilibrium process in which the material undergoes phase transformation and even ablation in an extremely short time range. This is the coupling of the thermos elastic effect caused by the pressure wave and the superheated melting of the material lattice. To further explore the mechanism of the action of ultrafast laser and metal materials, the two-temperature model coupling with molecular dynamics method was used to simulate the interaction of the copper and laser energy. Firstly, the interaction of single-pulsed laser and copper film was reproduced, and the calculated two-temperature curve and the visualized atomic snapshots were used to investigate the influence of laser parameters on the ablation result. Then, by changing the size of the atomic system, the curve of ablation depth as a function of laser fluence was obtained. In this paper, the interaction of multi-pulsed laser and copper was calculated. Two-temperature curve and temperature contour of copper film after the irradiation of double-pulsed and multi-pulsed laser were obtained. And the factors which can make a difference to the incubation effect were analyzed. By calculating the ablation depth under the action of multi-pulsed laser, the influence of the incubation effect on ablation results was further explored. Finally, a more accurate numerical model of laser machining metal is established and verified by an ultra-short laser processing experiment, which provides a new calculation method and theoretical basis for ultra-fast laser machining of air film holes in aviation turbine blades, and has certain practical guiding significance for laser machining.

A R T I C L E I N F O

Keywords:
Ultrafast laser,
Multi-pulsed laser;
Ablation;
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