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DOUBLE-PULSE NANOSECOND LASER ABLATION OF METALS

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Nanosecond laser exhibits the advantage of high achievable intensities, reasonably small heat-affected zone, and low cost compared to ultrafast lasers. It is ideal for performing precision processing with excellent material removal rates for applications in microelectronics, materials processing, and medical device manufacturing, etc. Hence, the enhancement of laser drilling efficiency is very desirable. A very interesting physical phenomenon has been discovered with experiment: the double-pulse nanosecond laser ablation can significantly increase the laser ablation depth, compared with the single pulse ablation under the same laser energy input. In addition, the low-high double-pulse sequence, where a low-energy laser pulse precedes a high-energy laser pulse, gives an even deeper ablation depth than the high-low sequence, vice versa. In this study, a hydrodynamic model is built to simulate the nanosecond laser ablation of metals by both single and double pulses. The predicted ablation depths agree well with the experimental measurement. The study shows that, due to the preheating effect and laser-induced pressure gradient, double-pulse ablation leads to higher laser absorption rate, and pushes the high temperature materials near the surface deep into the bulk sample, which significantly enhances the heat transfer process, resulting in a deeper depth.

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