Accepted Manuscript

Full Length Article

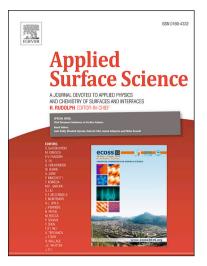
Numerical study of material decomposition in ultrafast laser interaction with metals

Xiao Jia, Xin Zhao

Accepted Date:

PII: DOI: Reference:	S0169-4332(18)32368-7 https://doi.org/10.1016/j.apsusc.2018.08.225 APSUSC 40262
To appear in:	Applied Surface Science
Received Date:	12 December 2017
Revised Date:	29 July 2018

26 August 2018



Please cite this article as: X. Jia, X. Zhao, Numerical study of material decomposition in ultrafast laser interaction with metals, *Applied Surface Science* (2018), doi: https://doi.org/10.1016/j.apsusc.2018.08.225

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

ACCEPTED MANUSCRIPT

Numerical study of material decomposition in ultrafast laser interaction with

metals

Xiao Jia, and Xin Zhao Department of Mechanical Engineering College of Engineering, Computing and Applied Sciences Clemson University, Clemson, SC 29634-0921, USA

Abstract

A study of ultrafast laser-induced ablation of metals is presented based on an improved twotemperature model. Material decomposition and the resultant energy loss from the sample are considered through the dynamic description of the ablation process. The boiling temperature is adopted as the ablation initiation temperature to capture the contributions from multiple ablation mechanisms. Ablation occurrence period, ablation depth, threshold fluence, residual thermal energy and melting layer thickness have been studied for aluminum, copper, and gold. The simulation results agree well with the experimental measurements for different materials and laser parameters. The electron-phonon coupling strength and thermal conductivity are found to be critical factors determining ablation behaviors. With strong electron-phonon coupling and low thermal conductivity (like aluminum), ultrafast ablation can be triggered within hundreds of femtoseconds, leading to a more efficient laser energy deposition, high ablation depth, and thin melting layer.

Keywords: Ultrafast laser, laser-matter interaction, ablation, two-temperature model, heataffected zone

1 Introduction

Ultrafast (pulse duration shorter than 10 ps) laser-induced ablation (ULIA) of metals, with low ablation threshold, high processing efficiency, and small heat-affected zone (HAZ), has been a subject of interest for decades due to its great potential for high-precision micromachining. Extensive experimental and numerical investigations [1-6] have been devoted to the study of

Download English Version:

https://daneshyari.com/en/article/10141414

Download Persian Version:

https://daneshyari.com/article/10141414

Daneshyari.com