Accepted Manuscript

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PII: S0925-8388(18)30183-X

DOI: 10.1016/j.jallcom.2018.01.182

Reference: JALCOM 44646

To appear in: *Journal of Alloys and Compounds*

Received Date: 5 August 2017

Revised Date: 12 January 2018

Accepted Date: 13 January 2018

Please cite this article as: F. Dai, J. Geng, X. Ren, J. Lu, S. Huang, Dynamic response of surface micro-features subjected to a laser shock wave planishing technique, *Journal of Alloys and Compounds* (2018), doi: 10.1016/j.jallcom.2018.01.182.

Dynamic response of surface micro-features subjected to a laser shock wave planishing technique

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Abstract

A periodic micro-groove was fabricated on the surface of LY2 aluminum samples using a picosecond laser system, and then the samples were subjected to a laser shock wave planishing (LSWP) treatment. The deformation of micro-features was evaluated using a non-contact 3D profilometer. The experimental results show that LSWP can effectively lower the height of the micro-features. An axisymmetric 2D model was constructed to simulate the dynamic response of the micro-features at a strain rate of 10^6 s^{-1}. The profile of micro-features predicted from the finite element modeling matches quite well with the experimental results. The simulated dynamic deformation of micro-features clearly reveals the plastic flow behaviors of the surface materials after the LSWP treatment and provides useful optimized LSWP parameters to control the roughness and profile accuracy of the treated surface.

Keywords: Surface roughness; Finite element modeling; Laser shock wave; Plastic flow; Micro-features; Aluminum alloy

1. Introduction

Surface roughness plays a highly important role in the fatigue and aerodynamic performance of aero-engine blades [1,2]. A subsequent polishing process for blades is

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