

Forming of micro features using laser technology

Yang, Juntao

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School of Mechanical and Aerospace Engineering

Student: Yang Juntao

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Introduction

This research aims to develop a micro features manufacturing method on stainless steel by LASER shockwave forming process. The relationship between LASER intensity, pulse number and the microstructure formed during the process is investigated. In a certain range, LASER can vaporize the coating on the material foil and result in a plasma shock wave. The pressure created by the shock wave will form a dome structure on the sheet regardless of the LASER beam shape.

Procedures

1. Set up

- Stainless steel AISI 316 (Fe/Cr/18/Ni10/Mo3) is chosen as the testing material in the LASER shockwave forming research. 25 μ m thick foil is used.
- 15 μ m thick aluminum foil overlay is used. Its low melting point perfectly matches the requirement of the coating material in this research.
- Silicon rubber is used as the base so that structure deformation is allowed.
- Rofin Nd:YAG LASER with maximum intensity 0.55GW/cm² is used as the LASER source.

2. Experiment

- LASER test: By using variable control, the material is tested at different LASER intensities and pulse numbers.
- Talyscan surface profiler is used to measure parameters of the microstructure formed like area and depth.

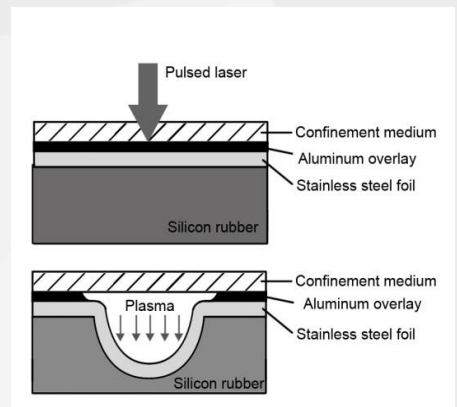


Figure1. Mechanism of LASER shockwave forming

Results

Results show that LASER shockwave forming is an efficient way to produce microstructures. Regardless of the shape of the LASER beam, circular shape microstructures are always formed. Data has shown that the depth of the structures are approximately linearly related with the intensity of the LASER beam.

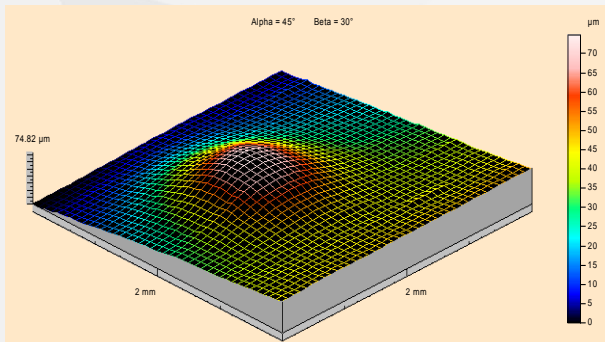


Figure2. Dome microstructure formed after LASER dynamic process

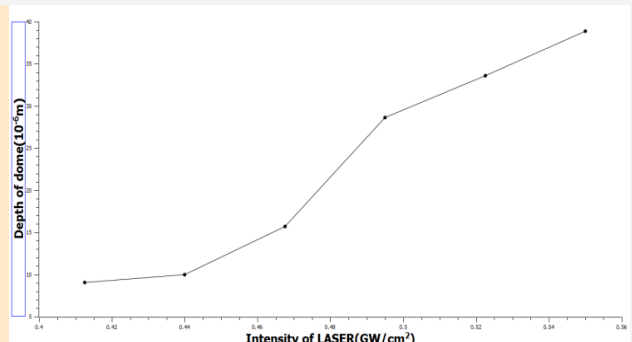


Figure3. Depth of dome structure verse LASER intensity

Applications

LASER shockwave forming has high potential for applications in manufacturing of micro-electric-mechanical systems (MEMS) because of its ability to produce micro-structures on thin metallic foils.