Thermo-chemical microstructuring of thin metal films using multi-beam interference by short (nano- & picosecond) laser pulses

Mindaugas Gedvilas, Bogdan Voisiat, Simonas Indrišiūnas, Gediminas Račiukaitis, Vadim Veiko, Roman Zakoldaev, Dmitry Sinev, Elena Shakhno

PII: S0040-6090(17)30343-7
DOI: doi: 10.1016/j.tsf.2017.05.010
Reference: TSF 35966

To appear in: *Thin Solid Films*

Received date: 23 September 2016
Revised date: 8 March 2017
Accepted date: 7 May 2017

Please cite this article as: Mindaugas Gedvilas, Bogdan Voisiat, Simonas Indrišiūnas, Gediminas Račiukaitis, Vadim Veiko, Roman Zakoldaev, Dmitry Sinev, Elena Shakhno , Thermo-chemical microstructuring of thin metal films using multi-beam interference by short (nano- & picosecond) laser pulses, *Thin Solid Films* (2017), doi: 10.1016/j.tsf.2017.05.010

Thermo-Chemical Microstructuring of Thin Metal Films using Multi-Beam Interference by Short (Nano- & Picosecond) Laser Pulses

Mindaugas Gedvilas[a], Bogdan Voisiat[a], Simonas Indrišiūnas[a], Gediminas Račiukaitis[a], Vadim Veiko[b], Roman Zakoldaev[b,*], Dmitry Sinev[b], Elena Shakhno[b]

[a]Center for Physical Sciences and Technology, Savanoriu Ave. 231, LT-02300, Vilnius, Lithuania

[b]ITMO University, Kronverksky Ave. 49, St. Petersburg, 197101, Russia

*Corresponding author. Tel.: +7-911-144-52-56

E-mail address: zakoldaev@gmail.com

Abstract

Interference of laser beams with a high pulse energy opens an opportunity of direct oxidation of surfaces over large areas. It is important to confirm that the single ultrashort laser pulse irradiation is able to create the protective oxide layer on chromium films. Here, we report an approach of hybrid thermo-chemical treatment of thin chromium films irradiated by laser beam interference utilising picosecond and nanosecond laser pulses combined with the subsequent chemical etching. The array of periodical structures with a period of 1.5 - 3.5 μm and array size of 300 × 300 μm^2 were created on the chromium film. Theoretical modelling combining the laser heating of a thin film by the multi-beam interference and growth of the oxide layer is discussed. Confirmed thermo-chemical microstructuring of thin metal films using multi-beam interference opens the opportunities in fabrication of low-cost and high-quality diffractive optical elements.

Keywords: Thin films; Laser treatment; Oxidation; Microstructures; Modelling.