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PII: S0169-4332(14)00075-0
DOI: http://dx.doi.org/doi:10.1016/j.apsusc.2014.01.047
Reference: APSUSC 27055

To appear in: *APSUSC*

Received date: 28-9-2013
Revised date: 10-12-2013
Accepted date: 9-1-2014

Please cite this article as: L. Skowroński, A.J. Antończak, M. Trzcinski, L. Lazarek, T. Hiller, A. Bukaluk, A.A. Wronkowska, Optical properties of laser induced oxynitride films on titanium, *Applied Surface Science* (2014), http://dx.doi.org/10.1016/j.apsusc.2014.01.047

Optical properties of laser induced oxynitride films on titanium

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Highlights

- The optical properties of laser-induced films on titanium were studied.
- The thickness of the oxide films (20÷40 nm) increased linearly with the fluence.
- The oxynitrides in the scales formed on titanium have been found.
- We found an absorption band in the visible-light wavelength range.
- It follows that the color formation results from interference and absorption.

Abstract

This paper presents a study of the optical properties and chemical composition of laser-induced color oxynitride films formed on titanium substrates in a normal-pressure atmospheric environment. The samples were investigated by spectroscopic ellipsometry and X-ray photoelectron spectroscopy. The influence of the laser fluence F on the optical properties of oxynitride films has been found. The thickness of the layers ranges from ~20 nm to ~40 nm and increases linearly with F. The determined complex dielectric functions demonstrate two absorption bands, one of them appears in the visible-light wavelength range. We show that the color created by oxynitride films formed on the titanium surface depends not only on the interference effect as commonly assumed, but is also a function of the changes of the optical properties of these coatings.

Keywords: laser color marking, titanium, titanium oxides, colorimetry, CIE L*a*b*, color, fiber laser, dielectric function, spectroscopic ellipsometry

PACS: 81.65.-b (81.65.Mq), 42.62.Cf, 42.55.Wd, 07.60.Dq, 07.60.Fs, 78.20.Ci, 82.80.Pv

Introduction