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# EFFECTS OF MICRO- AND NANO STRUCTURES ON THE OPTICAL PROPERTIES OF THIN TITANIUM FILM

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**Abstract.** A major change in the properties of material surfaces caused by laser-induced periodic surface structures (LIPSS) can be found useful in the field of optics and energy technology. Using the example of increasing the efficiency of solar cells, it was shown that the reflection and absorption behavior can be specifically modified by micro- and nanostructuring of the surface. This technology can also be used to create anti-reflective surfaces, similar to those of the glass wing moth (Greta oto) or the moth eye. In this work-controlled generation of 1D and 2D structure on thin titanium film is demonstrated. The optical property of the generated structures is studied in the visible region, in order to create a protective hologram.

**Introduction.** The function of a material surface is largely determined by its topographical and chemical properties. With the help of a defined micro and/or nano structuring of the surface, unique functional properties can be realized [1]. There are many examples in nature in which functional properties based on structured surfaces play a central role, for example the lotus leaf with its self-cleaning, water-repellent surface [2], these natural models often serve as a source of inspiration in surface technology. the conventional nanostructuring techniques including lithography, sol-gel, thermal embossing, plasma treatments, chemical vapor deposition, chemical etching or electrodeposition require chemicals or long fabrication time due to slow or complicated multi step processes [3]. The possible alternative is direct laser thermochemical recording as a single-step, non-polluting, cost-effective, and flexible method for efficient and high-precision processing [4] [5]. Thermochemical LIPSS can be generated in a simple singlestep low-temperature process, which allows a high-resolution surface nanostructuring for tailoring optical, mechanical, and chemical surface properties [6].

**Main part.** In this work, we present a new approach for the fabrication of 2D structure based on LIPSS, laser system Minimarker 2 (Laser Center, LLC) based on the ns-pulsed ytterbium fiber laser ($\lambda$=1064nm) was used for creation nano-scale periodic structure known as TLIPSSs on titanium thin film. the 2D structure was generated by achieving cross scanning area between two orthogonal laser tracks. In order to analyze the effect of the laser polarization on the generated structure, the relative polarization difference between the two truck was changed from 0 to 180 degrees. Spectral analysis of the structures was conducted using an Avantes fiber spectrometer connected to a Carl Zeiss Axio Imager optical microscope. depending on the spectral analysis we managed to create a protective hologram consisting of sections with diffractive micrograting and have different spatial orientations.

**Conclusion.** The controlled generation of a variety of 2D-LIPSS on thin titanium film via cross-scanning irradiation is demonstrated. Homogeneous Honeycomb 2D-LIPSS were obtained for polarization difference $\alpha$ between two orthogonal tracks is in the range from 32 degree to 64 degree, and square 2D-LIPSS were obtained for polarization difference $\alpha$ is in the range from 66 degree to 90 degree. Also, a protective hologram with the functions of diffractive filters is created.

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