A SELF-ORGANIZATION PHENOMENON IN THE LASER SYNTHESIS OF NITRIDES ON TITANIUM, ZIRCONIUM AND HAFNIUM SURFACES IN A LIQUID NITRIGEN MEDIUM

T. Khatko

To cite this version:

T. Khatko. A SELF-ORGANIZATION PHENOMENON IN THE LASER SYNTHESIS OF NITRIDES ON TITANIUM, ZIRCONIUM AND HAFNIUM SURFACES IN A LIQUID NITRIGEN MEDIUM. Journal de Physique IV Colloque, 1991, 01 (C7), pp.C7-141-C7-141. <10.1051/jp4:1991737>. <jpa-00250940>

HAL Id: jpa-00250940
https://hal.archives-ouvertes.fr/jpa-00250940
Submitted on 1 Jan 1991

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L’archive ouverte pluridisciplinaire HAL, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d’enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.
A SELF-ORGANIZATION PHENOMENON IN THE LASER SYNTHESIS OF NITRIDES ON TITANIUM, ZIRCONIUM AND HAFNIUM SURFACES IN A LIQUID NITRIGEN MEDIUM

T.N. KHATKO

Physical and Engineering Institute of Academy of Sciences of BSSR, Zhodinskaya 4, Minsk 220730, USSR

It is shown theoretically and experimentally that a chemical medium subject to laser radiation acquires the ability to self-organization. This process can be controlled by changing laser beam parameters, i.e. intensity, a beam radius and wavelength. It is known that on titanium, zirconium and hafnium surfaces placed into liquid nitrogen and subjected to laser radiation there proceeds chemical synthesis of nitrides. Here a melting surface chemically interacting with nitrogen plays the main role. In the present work it has been revealed experimentally that at millisecond IR-laser irradiation (λ = 1.6 μm) of titanium, zirconium and hafnium surfaces being in a liquid nitrogen medium there is observed a self-organization phenomenon in a thin surface layer of melted metal interacting with nitrogen which results in formation of a 5-20 μm layer with a structure that differs essentially from that of a melting zone. Scanning electron microscopy and metallographic examination have revealed that the surface layer of a melting zone formed on a titanium surface consists of columnar TiN crystals having the same size and being equidistant from each other. Similar structures have been observed on zirconium and hafnium surfaces. A cross size and height of TiN crystals as well as a distance between them have depended on laser radiation power density \( q = 10^5 - 10^6 \text{W} \cdot \text{cm}^{-2} \), impulse duration \( t' = 1-6 \text{ms} \) and a spot radius \( r = 500-2000 \mu \text{m} \). At \( q = 1,2 \cdot 10^6 \text{W} \cdot \text{cm}^{-2}, t = 4 \text{ms} \) and \( r = 1 \text{mm} \) the above parameters have amounted to 1.5; 10 and 2.5 μm, respectively.