MECHANISMS OF DOPING METALS FROM GAS AND LIQUID MEDIUMS BY THE ms-LONG Nd-LASER PULSES

V.M. BORISOV, A.M. KOVALEVICH and Yu.Yu. STEPANOV

The Troitsk Kurchatov Research Institute, Troitsk, Moscow Region 142092, USSR

Ultra-high concentrations (67 atomic per cent) doping elements (carbon) have been reached in the suggested method of the laser treatment of the metals under liquid. The system iron-toluol was used in this experiment as an example. The mechanism of transportation of doping elements into the melt zone (thickness up 100 μm) is shown to be determined both experimentally and numerically by convectional mixing of the melt metal because of the action of backing vapor forces.

The treatment of the metals ($I=1.5 \times 10^5 \text{ W/cm}^2$) in the gas-reagents with various chemical activity has demonstrated that the doping process has a character of thermo-chemical interaction of the melt metals with ambient gas. The following table represents some microhardnesses and nitrogen concentrations for Fe and Ti samples treated in N_2 and NH_3 gases at near 1 atm.:

	Fe- N_2	Fe- NH_3	Fe-VAC.	Ti- N_2	Ti- NH_3	Ti-VAC
$H_{\mu}^{100} \text{ max}$	550	650	350	2300	700	210
$\bar{H}_{\mu}^{100}$	425	525	350	1300	500	210
$C_{\text{N max}} \text{ at } \%$	<1	<1	---	50	15	---

Dynamic of the laser "flash" measured by the streak camera and its temperature measured by spectral diagnostic method are discussed. Numerical modeling of heating and melting of the metals by the free-generated regime Nd-laser's pulse are discussed too.