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STRUCTURE CHANGES IN SEVERAL METALS AFTER THEIR LASER TREATING IN DIFFERENT CONDITIONS

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The radiation of the GOR-100M ruby laser (λ = 0.694 mm) operating in the free oscillation regime (pulse duration ~1.2 mc) passed through the focusing system and was directed onto the surface of metal (Ti, Cd, Cu, In) sample. Both mono-lens and two-lens systems were used for focusing of laser radiation. This avoided to form an image of a diaphragm on the surface of irradiated sample as a spot with the sharp borders. During the experiments a spot diameter was varied from 1 to 3 mm. This avoided to vary the flux density of laser radiation q from 10^4 to 10^6 W cm^{-2}. The energy of the laser pulses varied from 5 to 50 J. The samples were treated from one and from both sides.

For determination of structure changes in metal samples (continuous polycrystalline) having in equilibrium state the cubic side-centered crystalline grid before and after action of laser radiation we used X-ray difractometer DRON-2.0. Radiation K_α-line from the tube with copper anticathode filtered by standard nickel filter on wavelength 154,050 pm was used in the difractometer.

Calculation of temperature changes after action on the target of each pick of free oscillation pulse was also fulfilled.

During interaction of laser radiation with matter a number of changes in the treated sample can take place: changes of chemical composition of matter, phase transitions, defects of new types appearance, increase of already existing defects concentration, changes of inter-crystalline planes properties.

For the titanium samples treated by laser radiation with the flux density of radiation q ~ $5\cdot10^4$ W cm^{-2} splitting of correlation function maxima was not observed. However the width of X-ray difractograms was essentially changed. This effect testifies the considerable growth of crystalline grid defects concentration in the irradiated zone. Micro-hardness of titanium samples in the irradiated zones also considerably increased. The calculations show that after treating of titanium sample by laser radiation with the flux density q ~ $5\cdot10^5$ W cm^{-2} number of crystalline elementary cells were subjected to the transformation from the cubic side-centered to the distorted (having a form of parallelepiped, different from the cub) can reach 50 %.

For copper samples irradiated by laser beam with the flux density of radiation q ~ $5\cdot10^5$ W cm^{-2} not only erosion but even splitting of the first maximum of correlation function was observed. It testifies to the transformation of the matter crystalline structure after its laser treating. In the irradiated zone the form of the crystalline elementary cell was changed from the cubic side-centered to the distorted (having a form of parallelepiped, different from the cub). Micro-hardness of metal samples in the irradiated zones considerably (30 % and even more) increased. It is also to be mentioned that after treating of copper sample by laser radiation with the flux density enough for the melting of metal in the irradiated zone (q > 10^6 W cm^{-2}) any changes of X-ray difractograms were not observed and micro-hardness of metal samples in the irradiated zones slightly decreased.

Estimation of the height of the first maxima of correlation functions before and after laser treating of copper samples permitted us to discover that 83 % of crystalline elementary cells were subjected to the transformation from the cubic side-centered to the distorted (having a form of parallelepiped, different from the cub). These data are in good consent with the results of calculations (~ 80 % of total number of the crystalline elementary cells).