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MODELLING OF LASER INDUCED METALLURGICAL TRANSFORMATIONS IN TITANIUM ALLOYS AND CARBON STEELS

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The laws of phase $\alpha+\beta \rightarrow \beta$ -transformation in Ti-6Al-4V alloy and $\alpha \rightarrow \gamma$ -transformation in eutectic carbon steel during heat treatment using laser irradiation have been established.

The coefficient of vanadium diffusion in titanium alloy is known to be much less than the coefficient of carbon diffusion in steel in the same conditions. It leads to a different rate and degree of completing of phase transformations in titanium alloy and steel. The evaluation of these effects was performed by solving diffusion equations with the appropriate boundary conditions.

It is shown that at a definite heating rate a diffusive phase transition mechanism turns into the diffusionless one. The values of these "critical" heating rates were estimated to be 10^2 C/s for titanium alloy and $10^4 - 10^5$ C/s for steel. Comparing these values with average heating rates during laser irradiation it is possible to make a conclusion about the degree of diffusion or diffusionless mechanism realization.

It is shown that during continuous CO_2 -laser heating even up to the melting point the $\alpha+\beta \rightarrow \beta$ -transformation in titanium alloy proceeds mainly by a non-diffusion mechanism, the phase composition after cooling being determined by the degree of completion of β -phase homogenization process. On the contrary $\alpha \rightarrow \gamma$ -transformation in steel during laser irradiation proceeds by a diffusion mechanism. On the basis of calculated data the suitable hardening regimes of laser heat treatment are also discussed.