

ABSTRACT

HEAT EQUATION, FDTD METHOD, PULSE LASER PROCESSING,
COMSOL MULTIPHYSICS 5.2

Master's thesis: ___ pages, ___ figures, ___ tables, ___ sources.

The object of study thermal effect of laser irradiation surface of hydroxyapatite.

Purpose – Search minimum laser power to strengthen the hydroxyapatite layer by numerical solution of three-dimensional heat equation in the software environment COMSOL 5.2.

Methods: numerical solution of the three-dimensional heat conduction equation in the software environment COMSOL 5.2 finite difference method; approximation by polynomials of temperature dependences of thermal properties of 40X and 40X13 steels.

Scientific novelty of the obtained results: on the basis of the obtained results, it was concluded that the use of the beam with the Gaussian distribution for laser quenching is inappropriate, since the martensitic transformation that strengthens the surface of steels during laser quenching occurs at significantly smaller distances between adjacent laser spots.

Application: laser hardening of the surface of materials.

Increasing the lifetime of steel products is a topical issue. One of the methods of its solution is thermal treatment, which facilitates the formation of the desired phases and structures. The advantages of laser heat treatment are:

Local heating of near-surface layers of material;

Small time of quenching;

Rapid heating and cooling of the surface;

Ecological compatibility of the technological process;

Relative simplicity of handling of processing parameters.

The literature related to the laser hardening of the surface of steels, in particular steels 40X and 40X13, was studied. The problem of heat conduction with

respect to heating the surface of samples of steels 40X and 40X13 by the point pulse source of radiation (laser) is solved. The results can be applied to carry out the appropriate experiment.