

Electromagnetic Processing of Metal as Coupling of Multi-Physics Phenomena

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ABSTRACT

The mathematical model of the induction heat treatment takes into account electromagnetic and thermo-mechanical effects and phase transformations phenomenon. Different approaches of electromagnetic calculations are analyzed [1]. The mechanical effects modeling is based on the elastoplastic constitutive equations with von Mises yield criterion. The problems of the empirical TTT-diagram are described. In contrast it is analyzed the possibilities of thermodynamic based model.

Mathematical model for the induction melting of metal is comprising computation of electromagnetic, temperature, MHD fields after getting melt zone and dynamic of its growth. The calculation of the melting process has been carried out by the method “enthalpy-porosity” with application of models of turbulent currents $k-\omega$ SST in a non-static setting. Electromagnetic forces and heat sources have been defined by solving a harmonic task by the method of finite elements on a vector magnetic potential in the system “inductor – load” for each iteration of the hydrodynamic task. Experiments confirmed need in simulation of MHD fields to receive good coincidence with physical experiments. Using of the developed models for simulation of electromagnetic processing billets make it easy to develop and implement optimal heat processing systems for the crucibleless induction melting of titanium alloys [2].

REFERENCES

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