Computer Simulation of Laser Welding Technology of Chrome-Nickel Steels in Automotive Industry and its Verification by Means of Electron Microscopy

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Numerical simulation of technological processes enables their exact description and it makes possible to get closer to the real process courses. The described method uses mathematical models transformed into the finite element method. The processes of interaction of the laser beam with the surface of austenitic stainless steel are first observed on simple geometrical models. Hereby the basic parameters of the processes are analyzed, and individual welding stages are described as dynamic fluid systems, in which steel is in a liquid state and it behaves as an incompressible fluid, while it is simultaneously loaded by the heat flux from the laser beam. Subsequently, three-dimensional models are analyzed using thermal and structural elements. Due to the high density of heat flow in the material, an orthotropical material model with equivalent coefficients of thermal conductivity of steel has to be used. The results obtained by numerical analyzes represent a sufficient picture of the behavior of the material when exposed to the laser beam, and they show the distribution of temperature, velocity and stress fields during welding. The acquired knowledge can be suitably used both in the automotive industry and also in many other industry branches.

Keywords: Computer simulation, Welding, Bodywork, Austenitic stainless steel, Electron microscopy

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