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FINE STRUCTURE OF THE SUPERALLOY COMPONENTS FORMED BY ELECTRON BEAM ADDITIVE MANUFACTURING*

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Superalloys of the second and subsequent generations [1] are used for manufacturing by casting with directed solidification of gas turbine engines working blades for aviation and power purposes [2]. At the same time, the currently widespread casting technologies with directional solidification are extremely resource-intensive in all practical aspects. Both in terms of the formation of a large proportion of virtually irrecoverable, or difficult to regenerate, waste of expensive materials. Also in terms of labor intensity with many technological transitions, equipment complexity, etc.

In the near future, the development of the potentialities of intensively developing additive technologies may allow reducing the technology of turbojet engine blades with a single-crystal microstructure to several operations [2].

An analysis of the results of studies carried out by the team of this work authors showed that in the process of electron-beam additive technology (EBAM) from filaments in the form of superalloy rods [3], it is possible to form products with a directed columnar microstructure [4]. In this case, directional solidification occur exclusively antiparallel to the direction of the temperature gradient. As a rule, with an increase in the height of the additive product it changes its direction from normal to the plane of the surface of the cooled substrate to the co-directional printing trajectory in layers. To control the structure of the material of an additive product, it is necessary to understand the principles of solidification under conditions, multidirectional components of heat removal, as well as various values of linear energy (energy input per unit length) [5].

This paper presents the results of a qualitative and quantitative analysis of the fine structure, phase composition, and morphology of the structural elements of a complexly alloyed superalloy containing rhenium in the cast state, as well as in the material of an additive product formed by the EBAM method.

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