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## Study on criterion of fabricating columnar dendrite structure DZ466 superalloy based on LMC process

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### ABSTRACT

The directional solidification (DS) technology of superalloy is one of the most important manufacturing technologies for the industrial gas turbine (IGT), and the columnar dendrite structure and single crystal superalloy blades have been applied in IGTs at some internationally developed countries for many years, but China started up relevant work only in recent several years. Taking use of efficient 5/25 kg liquid metal cooling (LMC) DS apparatuses developed by Shenyang Research Institute of Foundry (SRIF) and through a method of combining DS tests with numerical simulations of temperature fields of samples, the evolution law of the relationships between the columnar dendrite structures and the constitutional supercooling criterion values ( $G_L/R$ ,  $G_L$  – temperature gradient in liquid phase at front of the solid–liquid interface, and  $R$  – solidification rate) for a typical nickel-based superalloy DZ466 has been investigated. The results show that when  $G_L/R \geq 1.5^\circ\text{C h/cm}^2$ , ideal columnar dendrite structure samples will be obtained and without equiaxed grains occurring in the samples. This study might provide a quantitatively computing basis for the LMC DS process design of the large-sized DZ466 nickel-based superalloy blade and contribute to avoid the misorientations or the equiaxed grains appearing in columnar dendrite structure castings.

**KEYWORDS:** LMC directional solidification, superalloy, columnar dendrite structure, criterion