

Title (en)

Process for producing a single-crystal component made of a nickel-based superalloy

Title (de)

Verfahren zur Herstellung einer aus einer Nickel-Basis-Superlegierung bestehenden Einkristallkomponente

Title (fr)

Procédé de fabrication d'un composant monocristallin constitué d'un superalliage à base de nickel

Publication

EP 2402473 A3 20131030 (DE)

Application

EP 11171088 A 20110622

Priority

CH 10582010 A 20100630

Abstract (en)

[origin: EP2402473A2] Producing a single-crystal component comprising a nickel-based superalloy or a directionally solidified component, comprises casting the component in a known manner, solution annealing for homogenization of the cast structure of the component, and carrying out two-step precipitation heat treatment comprising (a) determining a dendrite arm spacing in different areas of the cast component, (b) identifying a slowest diffusion element in the superalloy, (c) calculating the required time (t), (d) solution annealing the cast component, and (e) carrying out a two-step precipitation treatment. Producing a single-crystal component comprising a nickel-based superalloy or a directionally solidified component, comprises casting the component in a known manner to form a structure exhibiting dendrite, solution annealing for homogenization of the cast structure of the component, and carrying out a two-step precipitation heat treatment comprising (a) determining a dendrite arm spacing in different areas of the cast component, (b) identifying a slowest diffusion element in the composition of the respective nickel-based superalloy for determining the diffusion coefficients, (c) calculating the required time (t), which is necessary to ensure the segregation of the slowest element diffusion at #5% to reduce to a solution annealing temperature (T1), which on one hand is lower than the starting melt temperature, and on the other hand is high enough to lie in the required heat treatment window, (d) solution annealing the cast component comprising heating the component to the solution annealing temperature (T1), holding at this temperature (T1) with calculated time (t) in the step (c), and quenching the temperature (T1) at room temperature with a rate (v1) of #50[deg] C/minute, (e) carrying out the two-step precipitation treatment for separating the #'-phase at respectively lower temperatures (T2) and (T3) following the step (d), where the first step of the precipitation treatment comprises carrying out hot isostatic pressing process with an isostatic pressure greater than 160 MPa at the holding temperature (T2) and subsequent cooling of the temperature (T2) to room temperature with a cooling rate (v2) of greater than 50[deg] C/minutes, and the subsequent second step of the precipitation treatment comprises heat treatment of the component at a holding temperature (T3) and a subsequent cooling of the temperature (T2) to room temperature with a cooling rate (v3) of 10-50[deg] C/minute.

IPC 8 full level

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CPC (source: EP US)

C22C 1/02 (2013.01 - EP US); **C22F 1/10** (2013.01 - EP US)

Citation (search report)

- [A] US 4328045 A 19820504 - PEARSON DAVID D, et al
- [A] US 5820700 A 19981013 - DELUCA DANIEL P [US], et al
- [A] CHANG J-C ET AL: "DEVELOPMENT OF MICROSTRUCTURE AND MECHANICAL PROPERTIES OF A NI-BASE SINGLE-CRYSTAL SUPERALLOY BY HOT-ISOSTATIC PRESSING", JOURNAL OF MATERIALS ENGINEERING AND PERFORMANCE, ASM INTERNATIONAL, MATERIALS PARK, OH, US LNKD- DOI:10.1361/105994903770342953, vol. 12, no. 4, 2003, pages 420 - 425, XP001169993, ISSN: 1059-9495

Cited by

CN105689719A; EP3211111A3; CN110760770A; FR3121453A1; WO2022208004A1

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