

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 A2 20120104 (DE)

Application

EP 11171088 A 20110622

Priority

CH 10582010 A 20100630

Abstract (en)

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 γ' -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.

Abstract (de)

Die Erfindung betrifft ein Verfahren zur Herstellung einer aus einer Nickel-Basis-Superlegierung bestehenden grossen Einkristallkomponente oder gerichtet erstarrten Komponente, wobei die Komponente zunächst in bekannter Art und Weise unter Ausbildung eines Dendriten aufweisenden Gefüges in Form gegossen und nachfolgend ein Lösungsglühen zur Homogenisierung des Gussgefüges der Komponente sowie eine zweistufige Ausscheidungswärmebehandlung durchgeführt werden. Zur Vermeidung von chemischen Inhomogenitäten und dadurch hervorgerufenen inneren Spannungen wird u.a. ein HIP-Verfahrensschritt mit einem Druck grösser 160 MPa im Anschluss an das Lösungsglühen durchgeführt.

IPC 8 full level

C22F 1/10 (2006.01); **C22C 19/05** (2006.01); **C30B 33/02** (2006.01)

CPC (source: EP US)

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

Citation (applicant)

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- PESSAH-SIMONETTI, P. CARON, T. KHAN: "Effect of long-term prior aging on tensile behaviour of high-performance single crystal superalloy", JOURNAL DE PHYSIQUE IV, COLLOQUE C7, vol. 3, November 1993 (1993-11-01)

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