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US20150218675	High temperature TiAl alloy MTU AERO ENGINES
EP2851445	Creep-resistant TiAl alloy MTU AERO ENGINES
EP2620517	Heat-resistant TiAl alloy MTU AERO ENGINES
DE102012222745	Turbine blade, useful in fluid-flow machine e.g. stationary gas turbine or aircraft engine, comprises monocrystalline of titanium aluminide material in blade portion, and blade root made of polycrystalline material MTU AERO ENGINES
EP2990141	Method for producing TiAl components MTU AERO ENGINES
US20160010184	Al-RICH HIGH-TEMPERATURE TiAl ALLOY MTU AERO ENGINES

Method for manufacturing a TIAL blade ring segment for a gas turbine and corresponding blade ring segment

EP2695704

- **Patent Assignee**
  MTU AERO ENGINES
- **Inventor**
  RICHTER KARL-HERMANN
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- **Abstract:**
  (EP2695704)
  The method comprises forming blanks (3) of titanium-aluminum material, joining the blanks to a blade ring segment by a cohesive connection and then performing heat treatment, and post-processing the blank composite by material processes. The joining step is carried out by laser beam welding, electron-beam welding, high temperature brazing or friction welding, linear friction welding, orbital friction welding or multi-orbital friction welding. The titanium aluminum material is preheated at a brittle ductile transition temperature of the titanium aluminum during the laser beam welding. The method comprises forming blanks (3) of titanium-aluminum material, joining the blanks to a blade ring segment by a cohesive connection and then performing heat treatment, and post-processing the blank composite by material processes. The joining step is carried out by laser beam welding, electron-beam welding, high temperature brazing or friction welding, linear friction welding, orbital friction welding or multi-orbital friction welding. The titanium aluminum material is preheated at a brittle ductile transition temperature of the titanium aluminum during the laser or electron beam welding. The method further comprises soldering titanium-nickel base by inductive heating. The blanks are formed as a cube, a cuboid with protruding joint zones or as final contour components. An independent claim is included for a blade ring segment for a gas turbine.

Claims

(EP2695704)

1. A method for producing a blade-ring segment for a gas turbine, in particular for an aircraft engine, having at least two adjacent blades (21, 22) that have a single common blade root (25), wherein the method includes the following method steps: - forging of at least two blanks (1,2;3,4), - joining of the blanks to form a blade-ring segment by means of a method for substance-closing connection, and - re-processing of the blank composite by means of material-removing methods, characterised in that
the at least two blanks (1,2;3,4) are forged from a TiAl-material,
and during the joining of the blanks a joining zone (11) develops that extends through the centre or a central region of the common blade root (25).
2. A method according to claim 1,
characterised in that
one or more heat-treatments are carried out between the step of joining and re-processing by means of material-removing methods or after the re-processing by means of material-removing methods.
3. A method according to claim 1 or 2,
characterized in that
the joining is effected by laser-beam welding, electron-beam welding, high-temperature soldering or friction-welding, in particular linear friction-welding, orbital friction-welding or multi-orbital friction-welding.
4. A method according to one of the preceding claims,
characterised in that
the TiAl-material is pre-heated during the laser-beam or electron-beam wielding above the brittle-to-ductile transition temperature of the TiAl-material.
5. A method according to claim 3,
characterised in that
the soldering is carried out by means of local heating, in particular by means of inductive heating.
6. A method according to one of claims 3 or 5,
characterised in that
in particular Ti- or Ni-based solders are used for the soldering.
7. A method according to one of the preceding claims,
characterised in that
the blanks are formed as cuboids, as cuboids with protruding joining zones or as components with close to final contours.
8. A blade-ring segment for a gas turbine, in particular for an aircraft engine, consisting of a TiAl-material having at least two adjacent blades, prcduced in accordance with the method according to one of the preceding claims,
wherein at least two adjacent blades have a single common blade root, and wherein a joining zone (11) extends through the centre or a central region of the common blade root (25).

Method for producing forged tial components
WO201320548

- **Patent Assignee**
  MTU AERO ENGINES
- **Inventor**
  HELM DIETMAR
  HEUTLING FALKO
  HABEL ULRIKE
  SMARSLY WILFRIED
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WO2013020548	A1	2013-02-14	[WO201320548]
DE102011110740	A1	2013-02-14	[DE102011110740]
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EP2742162	A1	2014-06-18	[EP2742162]
US2014202601	A1	2014-07-24	[US20140202601]
EP2742162	B1	2015-10-07	[EP2742162]
ES2553439	T3	2015-12-09	[ES2553439]

- **Abstract:**
  (EP2742162)
  The present invention relates to a method for producing forged components of a TiAl alloy, in particular turbine blades, wherein the components are forged and undergo a two-stage heat treatment after the forging process, the first stage of the heat treatment comprising a recrystallization annealing process for 50 to 100 minutes at a temperature below the / transition temperature, and the second stage of the heat treatment comprising a stabilization annealing process in the temperature range of from 800° C. to 950° C. for 5 to 7 hrs, and the cooling rate during the first heat treatment stage being greater than or equal to 3° C./sec, in the temperature range between 1300° C. to 900° C. (From US2014202601 A1)

Claims

(EP2742162)

1. A method for producing forged components from a TiAl alloy, in particular turbine blades, in which the components are forged and after forging are subjected to a two-stage heat-treatment, wherein the first stage of the heat-treatment comprises recrystallization annealing for 50 to 100 minutes at a temperature below the gamma /alpha - transition temperature, namely in the temperature range between 1300 deg.C and 900 deg.C, in particular a recrystallization cooling temperature between 1200 deg.C and 1300 deg.C, and the second stage of the heat-treatment comprises stabilization annealing in the temperature range of 800 deg.C to 950 deg.C for 5 to 7 hours, and wherein a TiAl alloy having 42 to 45 at. % aluminium, 3 to 5 at. % niobium and 0.5 to 1.5 at. % molybdenum is used, characterised in that the rate of cooling in the first heat-treatment stage is greater than or equal to 3 deg.C/s in order to set a fine lamellar structure of alpha 2-Ti3Al and gamma -TiAl in a corresponding alpha 2-and gamma -phase.

2. A method according to claim 1,
characterised in that
the recrystallization annealing is carried out for 60 to 90 minutes, in particular 70 to 80 minutes, and/or the stabilization annealing is carried out in the temperature range of 825 deg.C to 925 deg.C, in particular 850 deg.C to 900 deg.C, and/or for 345 to 375 minutes.

3. A method according to one of the preceding claims,
characterised in that
the temperature during the heat-treatment is set and held with an accuracy of a 5 deg.C to 10 deg.C upward and downward deviation from the desired temperature.

4. A method according to one of the preceding claims,
characterised in that
during the recrystallization annealing there is no fall below a temperature of 15 deg.C, in particular 10 deg.C, below the gamma /alpha transition temperature.

5. A method according to one of the preceding claims,
characterised in that
an alloy having C.05 to 0.15 at. % boron is used.

6. A method according to one of the preceding claims,
characterised in that
the component is produced by drop-forging in the alpha -gamma -beta -temperature range.

7. A method according to one of the preceding claims,
characterised in that
cast or hot-isostatically pressed blanks are used as the starting material for the forging.

8. A method according to one of the preceding claims,
characterised in that
after the second stage of the heat-treatment the component has a triplex structure, with a glabulitic gamma -TiAl phase, a B2-TiAl phase and a lamellar alpha 2-Ti 3Al and gamma -TiAl phase.

9. A method according to claim 8,
characterised in that
the proportion of the gamma -phase is 2 to 20 percent by volume, the proportion of the B2-phase is 1 to 20 percent by volume, and the proportion of the gamma -phase together with the B2-phase is 5 to 25 percent by volume.

Microstructure analysis for the quality control of TiAl components
EP2720032

- **Patent Assignee**
  MTU AERO ENGINES
- **Inventor**
  DR HEUTLING FALKO
  DR HELM DIETMAR
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- **Abstract:**
  (EP2720032)
  The method involves subjecting component in relation to the material sample to a heat treatment, so that component or the sample is aged at a temperature. The phase is in a single form in the microstructure and microstructure in the heat treatment temperature s formed by quenching the component. The sample is frozen in the heat treatment. The sample or the component is subjected, after quenching of an investigation by X-ray diffraction to qualitatively or quantitatively to identify the phase.

Claims

(EP2720032)

1. A method for the quality control of components which are formed from TiAl alloys or comprise these, in particular TNM alloys, and which are subjected to a heat-treatment, wherein the components have a structure which comprises at least one phase that is present in at least two different forms in the structure of the components,

characterised in that - at least one component or a sample that is identical with respect to the material is subjected to a heat-treatment step, - in which the component or the sample is aged at a temperature at which - the phase is present in a single form in the structure, and - the component or the sample is aged at a temperature in the range from 20 deg.C up to 50 deg.C under the gamma -solvus temperature, and - the structural state at the heat-treatment temperature is frozen by quenching the component or the sample from the temperature of the heat-treatment step in such a way that no lamellar gamma -TiAl is deposited, wherein the sample or the component in this state after quenching is subjected to an investigation by means of X-ray diffraction in order to identify the phase qualitatively and/or quantitatively.

2. A method according to claim 1,

characterised in that

the component or the sample together with other components of a batch are subjected to the heat-treatment step, and the components of the batch are subjected at least to one further heat-treatment step, and further characterisation of the components of the batch is effected after the further heat-treatment.

3. A method according to one of the preceding claims,

characterised in that

the component or the sample is prepared for the investigation by means of X-ray diffraction, wherein in particular by separation a measuring surface is produced in the interior of the component or the sample.

4. A method according to one of the preceding claims,

characterised in that

the method is used for components that comprise in addition to titanium and aluminium portions of niobium and molybdenum.

5. A method according to one of the preceding claims,

characterised in that

the heat-treatment step, in which the phase is present in a single form in the structure, is a heat-treatment step in which the gamma -phase is present in a globular form.

6. A method according to one of the preceding claims,

characterised in that

the evaluation of the diffraction patterns is effected in an automated manner.

Process and apparatus for applying layers of material to a workpiece made of tial DE102010026084

- **Patent Assignee**
  MTU AERO ENGINES
- **Inventor**
  RICHTER KARL-HERMANN
  HANRIEDER HERBERT
  DUDZIAK SONJA
  GRUENINGER ALBERT
- **International Patent Classification**
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DE102010026084	A1	2012-01-05	[DE102010026084]
WO2012069029	A2	2012-05-31	[WO201269029]
WO2012069029	A3	2012-07-26	[WO201269029]
EP2590773	A2	2013-05-15	[EP2590773]
US2013143068	A1	2013-06-06	[US20130143068]

- **Abstract:**
  (US20130143068)
  Applying at least one material layer on a workpiece (10) made of a material containing titanium aluminide, comprises: heating the workpiece in a locally restricted area by induction at a provided preheating temperature; and applying a powdery additive on the heated surface of the workpiece by deposition welding, preferably laser-, laser-powder-, plasma-, micro plasma-, tungsten inert gas or micro tungsten inert gas-deposition welding, where the additive comprises titanium aluminide. Independent claims are also included for: (1) surface finishing, plating, dimensional correction or repairing the workpiece, comprising preparing the workpiece, and applying at least one layer of the additive; (2) plating, dimensional correction or repairing the surface of a shank, preferably acute angled groove of a component made of the material containing titanium aluminide, where a zone of the workpiece in a region of a groove-radius (14) is not heated by a predetermined additional critical temperature of the material depending on the shape of the groove, and a coil is used for inductive heating of the workpiece and/or its position is adjusted relative to the groove in the groove, preferably its shape; (3) plating, dimensional correction or repairing a functional area of a Z-groove of a top cover strip of a turbine blade, a sealing fin on a turbine bladed discs, a blade tip of a compressor rotor blade or a portion of a casing of a turbo-machine; (4) producing a workpiece, preferably a turbine- or compressor blade, or a turbine- or compressor housing, or any of their parts,

comprising preparing a substrate made of the material containing titanium aluminide, and applying a layer of at least one additive until a predetermined contour of the workpiece is formed or packed; (5) a device for applying material layers on the workpiece by deposition welding, comprising a holding device for holding the workpiece, a feeding device for feeding a powdery, titanium aluminide-containing additive, a melting device for melting the additive, where the melting device is arranged for generating a laser- or plasma jet and for directing the laser- or plasma jet on the workpiece, and a preheating device for preheating the workpiece. A device is designed and equipped for carrying out the above mentioned method. The preheating device is designed and equipped for inductive, locally restricted heating the surface of the workpiece; and (6) a workpiece with at least one material layer. (From DE102010026084 A1)

Claims

(US20130143068)

18. A method for depositing at least one layer of material on a workpiece made of a material including a titanium aluminide, the method comprising the steps of: heating the workpiece in a localized region by induction to a predefined preheating temperature, the heating creating a heated surface of the workpiece; and

depositing an additive including titanium aluminide on the heated surface of the workpiece by build-up welding.

1-17. (canceled)

19. The method as recited in claim 18 wherein the build-up welding includes at least one of: laser build-up welding, laser powder build-up welding, plasma build-up welding, micro-plasma build-up welding, TIG build-up welding and micro-TIG build-up welding

20. The method as recited in claim 18 wherein the additive is in powder form.

21. The method as recited in claim 18 wherein the preheating temperature is at or above a critical temperature of a brittle-ductile phase transition of the material.

22. The method as recited in claim 21 wherein the preheating temperature is between 700 deg. C. and 800 deg. C.

23. The method as recited in claim 18 wherein the preheating temperature is below a predetermined second critical temperature of the material.

24. The method as recited in claim 18 wherein the additive includes a hard material.

25. The method as recited in claim 24 wherein the content of hard material in the additive is between 15% and 90%.

26. The method as recited in claim 25 wherein the hard material is titanium carbide.

27. The method as recited in claim 24 wherein the hard material includes at least one of titanium carbide, titanium boride and boron nitride.

28. The method as recited in claim 18 wherein the additive includes a titanium aluminide having an average grain size of 25 to 75 mu m.

29. The method as recited in claim 28 wherein the additive includes a titanium carbide having an average grain size of 3 to 45 mu m.

30. The method as recited claim 18 wherein the deposition step includes the steps of: depositing the additive in powder form on the surface of the workpiece; and

melting the deposited additive by a laser beam or a plasma jet.

31. The method as recited in claim 18 wherein during the deposition step, the additive in powder form is delivered through a nozzle coaxial with a laser beam or plasma or laterally to a laser beam or plasma jet.

32. The method as recited in claim 18 wherein the addition of the additive and its composition are controlled in such a way that they vary from region to region.

33. The method as recited in claim 18 wherein a power of a laser used in the method is 80 W to 4000 W.

34. The method as recited in claim 18 wherein an advance rate is between 100 and 1500 mm/min.

35. The method as recited in claim 18 wherein the additive is deposited in a plurality of adjacent lines.

36. The method as recited in claim 35 wherein the lines have a width of 0.2 to 5 mm and/or a thickness of 0.1 to 3 mm.

37. The method as recited in claim 36 wherein the lines overlap each other.

38. The method as recited in claim 37 wherein a degree of overlap of adjacent lines is 50 to 90%.

39. The method as recited in claim 18 wherein the deposition step is followed by a step of cooling the workpiece at a defined cooling rate to a cooling temperature.

40. The method as recited in claim 39 wherein the cooling temperature is between 500 deg. C. and 650 deg. C.

41. The method as recited in claim 39 wherein the cooling rate is between 5 K/min and 50 K/min.

42. The method as recited in claim 39 wherein the cooling step wherein the cooling temperature is higher than room temperature and further includes a step of uncontrolled further cooling to room temperature.

43. The method as recited in claim 18 wherein the material consists of the titanium aluminide.

44. A method for surface enhancement, hardfacing, dimensional correction, or repair of a workpiece, the method comprising the steps of: preparing the workpiece; and

depositing at least one layer of an additive using the method as recited in claim 18.

45. A method for surface enhancement, hardfacing, dimensional correction, or repair of a surface of a side of a notch of a component made of a material including titanium aluminide, the method including the method as recited in claim 44, wherein a workpiece zone in a region of a notch radius is not heated above a predetermined further critical temperature of the material, which is primarily dependent on the shape of the notch, and wherein a coil used for inductive heating of the workpiece and/or its position relative to the notch is/are adapted to the notch.

46. The method as recited in claim 45 wherein the coil is adapted to a shape of the notch.

47. The method as recited in claim 45 wherein the notch is an acute-angled notch.

48. The method as recited in claim 45 wherein the material consists of the titanium aluminide.

49. A method for hardfacing, dimensional correction, or repair of a functional surface of a Z-notch of a turbine blade tip shroud, a sealing fin on a turbine blisk, a tip shroud of a compressor rotor blade, or a housing part of a fluid flow machine, including the method as recited in claim 44.

50. A method for manufacturing a workpiece, the method comprising the steps of: preparing a substrate made of a material including a titanium aluminide; and

depositing at least one layer of an additive in accordance with the method as recited in claim 18 until a predetermined contour of the workpiece is formed or overfilled.

51. The method as recited in claim 50 wherein the material consists of the titanium aluminide.
52. The method as recited in claim 50 wherein the workpiece is a turbine or compressor blade or a turbine or compressor housing or a part thereof.
53. An apparatus for depositing layers of material on a workpiece by build-up welding, comprising: a holder for holding the workpiece;

a feeder for feeding an additive powder including a titanium aluminide;

a melter for melting the additive; and

a preheater for preheating the workpiece, the apparatus being configured and adapted to perform the method as recited in claim 18.
54. The apparatus as recited in claim 53 wherein the preheater is configured and adapted for localized inductive heating of a surface of the workpiece.
55. The apparatus as recited in claim 53 wherein the melter is adapted to produce a laser beam or a plasma jet and to direct the laser beam or plasma jet toward the workpiece.
56. A workpiece comprising at least one layer of material deposited in accordance with the method as recited in claim 18.

Wear-resistant layer for tial
DE102008056741

- **Patent Assignee**
  MTU AERO ENGINES
- **Inventor**
  BAYER ERWIN
  SMARSLY WILFRIED
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WO2010054633	A2	2010-05-20	[WO201054633]
WO2010054633	A3	2010-12-29	[WO201054633]

- **Abstract:**
  (WO201054633)
  The invention relates to a wear-resistant part for high-temperature applications made of a TiAl material, in particular a turbine blade comprising an at least double-layered protective coating (4). A first diffusion barrier layer (2) made of a precious metal and a second hard material layer (3) containing hard material particles that are embedded in a precious metal matrix are applied to the TiAl material (1) as a protective coating. The invention also relates to a corresponding production method.

Claims

(WO201054633)

Claims machine translated from German

PATENT CLAIMS

1. wear-protected construction unit for applications of high temperatures from a TiAl material by an at least two-layered protective layer (4), by the fact marked that a first diffusion barrier layer (2) from a precious metal and a second hard material layer (3) with hard material particles, which are stored in a precious metal matrix, on the Ti AI-material (1) when protective layer is applied.
2. Construction unit according to requirement 1, by the fact characterized that the Ti Al - material .gamma.-Ti Al, Ct [2] - Ti [3] Al or an alloy on basis of these inter+metallic phases is.
3. Construction unit after one of the preceding requirements, by the fact characterized that the diffusion barrier layer (2) from platinum, palladium, osmium, silver, gold or alloys of it is.
4. Construction unit after one of the preceding requirements, by the fact characterized that the precious metal matrix of the hard material layer (3) by platinum, osmium, silver, gold or
Alloys of it is formed.
5. Construction unit after one of the preceding requirements, by the fact characterized that the hard material particles (6) of the hard material layer nanoskalige particles is.
6. Construction unit after one of the preceding requirements, by the fact characterized that the hard material particles exhibit less (6) of the hard material layer a middle or maximum grain size of 500 Nm or.
7. Construction unit after one of the preceding requirements, by the fact characterized that the hard material particles exhibit less (6) of the hard material layer a middle or maximum grain size of 250 Nm or.
8. Construction unit after one of the preceding requirements, by the fact characterized that the hard material particles of the hard material layer less exhibit a middle or maximum grain size of 100 Nm or.
9. Construction unit after one of the preceding requirements, by the fact characterized that the hard material particles of the hard material layer from a ceramic material are.
10. Construction unit after one of the preceding requirements, thereby characterized that the hard material particles of the hard material layer cover at least one component of the group, the alumina, zircon oxide, diamond, diamond-similar carbon, boron nitride, cubic boron nitride (CBN), titanium nitride, titanium aluminum nitride, silicon oxide and silicon carbide contains.
11. Construction unit after one of the preceding requirements, by the fact characterized that on the Ti AI-material excluding the two -layered protective layer (4) is arranged.
12. Construction unit after one of the preceding requirements, by the fact characterized that the diffusion barrier layer (2) on the Ti AI-material and/or the hard material layer (3) is directly arranged when layer is trained.
13. Construction unit after one of the preceding requirements, by the fact characterized that the diffusion barrier layer (2) a thickness of 0,5 .micro.m to 10 .micro.m and/or the hard material layer a thickness of 0,1 .micro.m to 100 .micro.m exhibits.
14. Construction unit after one of the preceding requirements, by the fact characterized that the hard material particles (6) itself over the surface expansion and/or the thickness of the hard material layer (3) in its size, chemical composition and/or its portion in the hard material layer differentiates.
15. Procedure for the production of an at least two-layered wear-protection layer (4) on a Ti aluminum material (1), characterized to that-to production a diffusion barrier layer (2) a precious metal it is separated and that for the training of a hard material layer (3) in a precious metal matrix stored hard material particle to be separated.
16. Procedure according to requirement 15, by the fact characterized that a construction unit is manufactured after one of the requirements 1 to 13.
17. Procedure after one of the requirements 15 to 16, by the fact characterized that for the production of the diffusion barrier layer an organic precious metal connection with or without solvents on the Ti aluminum material is applied.
18. Procedure after one of the requirements 15 to 17, by the fact characterized that for the production of the hard material layer an organic precious metal connection with or without solvents with dispersed hard material particles is applied.
19. Procedure after one of the requirements 15 to 18, by the fact characterized that for the production of the diffusion barrier layer and/or the hard material layer an organic precious metal connection with a solvent portion of 30% and more is applied.
20. Procedure after one of the requirements 15 to 19, by the fact characterized that the organic precious metal connection with or without solvents is applied and with or without hard material particles by means of laser technology.
21. Procedure after one of the requirements 15 to 20, by the fact characterized that the organic precious metal connection with or without solvents is submitted and with or without hard material particles of a temperature treatment, so that existing solvent is evaporated and/or the organic precious metal connection is decomposed.
22. Procedure after one of the requirements 15 to 21, by it characterized that the organic precious metal connection covers at least one element from the group, those
Pt, Pd, OS, RH, Ru, cu, AG, outer one, IR and Mo contain.
23. Procedure after one of the requirements 15 to 22, by the fact characterized that first the diffusion barrier layer and afterwards the hard material layer are applied.
24. Procedure according to requirement 21, by the fact characterized that the temperature treatment for the diffusion barrier layer and/or the hard material layer takes place successively separately or together.
25. Turbine blade from a TiAl material marked by an at least two-day protection layer, by the fact that a first diffusion barrier layer from a precious metal and a second hard material layer with hard material particles, which are stored in a precious metal matrix are covered by the protective layer on the TiAl material.
26. Turbine blade according to requirement 25, by the fact characterized that it is designed as construction unit after one of the requirements 1 to 13.
27. Turbine blade according to requirement 25 or 26, by it characterized that in the range of a sealing surface a hard material layer

is intended, by an organic precious metal connection also opposite the remaining protective layer smaller solvent content laid on is covered and/or opposite the remaining protective layer more and/or larger hard material particles.

Heat-resistant tial alloy
WO201241276

- **Patent Assignee**
  MTU AERO ENGINES
- **Inventor**
  SMARSLY WILFRIED
  CLEMENS HELMUT
  GUETHER VOLKER
- **International Patent Classification**
  C22F-001/18
- **CPC Code**
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- **Publication Information**
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- **Priority Details**
  2010DE-10046049 2010-09-22

- **Fampat family**

WO2012041276	A2	2012-04-05	[WO201241276]
WO2012041276	A3	2012-11-01	[WO201241276]

- **Abstract:**
  (WO201241276)
  The invention relates to a heat-resistant TiAl alloy (and the production thereof), which in addition to unavoidable impurities comprises titanium, al, niobium, molybdenum, and carbon as alloying elements. The composition is selected in such a way that the carbon is dissolved into the mixed crystals of the alloy so as to substantially avoid carbide precipitations and the alloy is solidified from the melt exclusively by means of the ß-phase and/or ?-phase.

Claims

(WO201241276)

Claims machine translated from German

PATENT CLAIMS

1. Alloy on the Basis of [TiAl], which beside unavoidable Impurities as Alloying Constituents Titanium, Aluminum, Niobium, Molybdenum and Carbon over seize,
by the fact characterized that
the Composition is so selected that under large Avoidance of carbide eliminations Carbon is solved in the Mixed Crystals of the Alloy and the Solidification of the Alloy from the Melt is made exclusively by the ss-phase and/or .gamma.-phase.
2. Alloy according to claim 1,
by the fact characterized that
the Composition of the Alloy is so selected that the Stretch of the Alloy amounts to at a Temperature of 300.deg.C more largely or equivalent 1,1%, in particular more largely or equivalent 1,2%, preferably more largely or alike 1,3%.
3. Alloy according to claim 1 or 2,
by the fact characterized that
the Composition of the Alloy is so selected that at a Temperature of more than 700.deg.C of the Formation of the .omega.-phase one minimizes or one suppresses.
4. Alloy according to claim 1 or 2,
by the fact characterized that
the Alloy as the further Alloying Constituent Boron covers.
5. Alloy after one of the preceding claims,
by the fact characterized that
the Structure as fine-grained laminated Structure is adjusted, with which ***ss and .gamma.-grains in Lamella Colonies with an average Colony Size of under 150 are present .micro.n the Diameters, in particular smaller 100 .micro. .eta. Diameters.
6. Alloy after one of the preceding claims,
by the fact characterized that the Alloy of Portions of Aluminum with 42 to 44 RKs. - %, of Niobium with 1,0 to 4.9 RKs. - %, of Molybdenum with 0,5 to 3.0 RKs. - % and of Carbon with 0,1 to 1.0 RKs. - % exhibits.
7. Alloy after one of the preceding claims,
by the fact characterized that
the Alloy of Portions of Aluminum with 43 to 44 RKs. - %, of Niobium with 4,0 to 4.5 RKs. - %, of Molybdenum with 1,0 to 1.1 RKs. - % and of Carbon with 0,5 to 1.1 RKs. - % exhibits.
8. Alloy after one of the preceding claims,
by the fact characterized that
the Alloy Boron with a Portion from 0,05 to 0.2 RKs. - %, in particular with 0,1 to 0.15 RKs. - % exhibits.
9. Alloy after one of the [vohergehenden] claims, by the fact characterized that the Alloy Silicon with a Portion from 0 to 1 RK. - %, in particular 0.2 to 0.5 RKs. - % exhibits.
10. Alloy after one of the [vohergehenden] claims, by the fact characterized that the Alloy Yttrium, Lanthan and rare Earth Elements (SE) with a Total Portion from 0 to 1 RK. - % exhibits.
11. Procedure for the Production of an Alloy after one of the preceding claims with the following Steps:
a) Production of a Melt,
b) Solidify for the Melt exclusive over the ss-phase and .gamma.-phase,
c) Attitude fine-grained laminated Structures of a S.
12. Procedure according to claim 9,
by the fact characterized that
the Melt produced by Vacuum Electric Arc Melting and/or the Shaping via Casting one takes place and/or the Structure Attitude via Thermal Treatment and/or thermalmechanical Treatment, in particular hot-isostatic Pressing he
S follows.
13. Procedure after at least one of the claims 11 to 12, by the fact characterized that the [Gefugeeinstellung] takes place in Step c) via in or multi-level Thermal Treatment and/or via thermalmechanical Shaping.
14. Turbine Construction Part, in particular Direction or Rotor Blade of a Gas Turbine, with an Alloy after one of the claims 1 to 8, preferably manufactured with the Procedure after one of the claims 9 or 10.

Seal mount made from from titanium aluminide for a flow machine
EP2762684

- **Patent Assignee**
  MTU AERO ENGINES
- **Inventor**
  STIEHLER FRANK
  KLÄN STEPHAN
  BUSAM STEFAN
  THEIS BERNHARD
- **International Patent Classification**
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- **US Patent Classification**
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- **Publication Information**
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- **Priority Details**
  2013EP-0153184 2013-01-30

- **Fampat family**

EP2762684	A1	2014-08-06	[EP2762684]
US2014227080	A1	2014-08-14	[US20140227080]

- **Abstract:**
  (US20140227080)
  The turbomachine has a housing structure surrounding an annular flow channel. Rotating vanes are rotatably accommodated in the structure. Guide vanes are stationarily accommodated in the structure. The vanes are arranged in the channel. The guide vanes form an annular guide vane ring. The structure includes a seal (18) in a region of a radial inner flow channel boundary for sealing against hot gas output from the channel. The seal is arranged at bases (6) of the guide vanes above a seal mount (17), and sealed against a rotatable sealing surface. The mount is made of an intermetallic material. An independent claim is also included for a method for manufacturing a seal mount.

Claims
(US20140227080)
What is claimed is:
1.
A turbomachine, wherein the turbomachine comprises an annular flow duct and a housing structure surrounding the flow duct and a multiplicity of guide vanes and rotor blades which are arranged in the flow duct, the rotor blades being rotatably accommodated in the housing structure and the guide vanes being fixed in the housing structure, and a plurality of guide vanes forming an annular guide vane ring, and wherein the housing structure has a seal in a region of a radially inner flow duct boundary to prevent hot gas escaping from the flow duct, said seal being arranged on guide vane roots of the guide vanes of the guide vane ring via a seal support and forming a seal against a rotatable seal surface, said seal support being formed from an intermetallic material.
2. The turbomachine of claim 1, wherein the intermetallic material is a TiAl material and is formed of a titanium aluminide or comprises a titanium aluminide.
3. The turbomachine of claim 1, wherein the intermetallic material is a TNM alloy.
4. The turbomachine of claim 1, wherein the intermetallic material is a TNB alloy.
5. The turbomachine of claim 1, wherein the seal support is cast or forged and surface-processed.
6. The turbomachine of claim 1, wherein the seal support is formed as a one-piece ring.
7. The turbomachine of claim 2, wherein the seal support is formed as a one-piece ring.
8. The turbomachine of claim 1, wherein the seal support is present as several parts from a plurality of ring segments.
9. The turbomachine of claim 2, wherein the seal support is present as several parts from a plurality of ring segments.
10. The turbomachine of claim 1, wherein the seal support has, at a radially outer end, a connecting region for arranging on the guide vane roots and, at the radially inner end, an arrangement region for arranging the seal, an axially projecting blocking portion being formed between the radially inner end and the radially outer end.
11. The turbomachine of claim 10, wherein the blocking portion comprises at least one S-shaped bend.
12. The turbomachine of claim 10, wherein the blocking portion comprises a plurality of S-shaped bends.
13. The turbomachine of claim 10, wherein the intermetallic material is a TiAl material and is formed of a titanium aluminide or comprises a titanium aluminide.
14. The turbomachine of claim 1, wherein the seal is a brush.
15. The turbomachine of claim 1, wherein the seal is a honeycomb structure.
16. A method for producing a seal support for a turbomachine, wherein the method comprises casting or forging a semi-finished product for the seal support from an intermetallic material, and thereafter removing edge zones of the semi-finished product entirely.
17. The method of claim 16, wherein the intermetallic material is a TiAl material.
18. The method of claim 16, wherein the edge zones are removed by mechanical machining.
19. The method of claim 17, wherein the edge zones are removed by mechanical machining.
20. A method for producing a seal support for the turbomachine of claim 1, wherein the method comprises casting or forging a semi-finished product for the seal support from an intermetallic material, and thereafter removing edge zones of the semi-finished product entirely.

TiAl blade with surface modification
EP2808488

- **Patent Assignee**
  MTU AERO ENGINES
- **Inventor**
  DR WERNER ANDRÉ
  DR SMARSLY WILFRIED
- **International Patent Classification**
  C21D-007/04 C21D-007/06 C22F-001/00 C22F-001/18 F01D-005/28 F01D-025/00
- **US Patent Classification**
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- **CPC Code**
  C21D-007/04; C21D-007/06; C21D-009/50; C22F-001/10; C22F-001/18/3; F01D-005/28/6; F01D-005/28; F01D-025/00/5; F05D-2300/174; F05D-2300/60; Y10T-029/49229; Y10T-428/12472; Y10T-428/12993
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- **Priority Details**
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- **Fampat family**

EP2808488	A1	2014-12-03	[EP2808488]
US2014356644	A1	2014-12-04	[US20140356644]
DE102013209994	A1	2014-12-04	[DE102013209994]

- **Abstract:**
  (US20140356644)
  A component for a turbomachine having at least one region made of an intermetallic material which is formed from an intermetallic compound or comprises an intermetallic phase as the largest constituent. The intermetallic material is compacted and/or modified in microstructure by microplasticization at least partially at a surface or interface in a region close to the surface or interface. (From US2014356644 A1)

Claims

(US20140356644)

What is claimed is:

1.

A component for a turbomachine, wherein the component comprises at least one region made of an intermetallic material formed from an intermetallic compound or comprises an intermetallic phase as largest constituent, the intermetallic material being compacted and/or modified in microstructure by microplasticization at least partially at a surface or interface in a region close to the surface or interface.

2. The component of claim 1, wherein the at least one region comprises more than 50% by volume of the intermetallic phase.

3. The component of claim 1, wherein the intermetallic material is deformed at least partially at the surface or interface in a region close to the surface or interface.

4. The component of claim 1, wherein the interface is an interface to a coating of the component.

5. The component of claim 1, wherein the interface is an interface of an integral bond.

6. The component of claim 1, wherein the intermetallic material is selected from one or more of silicides, nickel aluminides, and titanium aluminides.

7. The component of claim 1, wherein the component is micro-alloyed and/or diffusion welded in a region of the microplasticization.

8. The component of claim 1, wherein the component comprises a titanium aluminide material.

9. The component of claim 8, wherein the component is a blade of a turbomachine comprising a titanium aluminide material.

10. The component of claim 1, wherein a blade of a turbomachine comprises a microplasticized region with a plating, or a microplasticized, micro-alloyed region in a region of a shroud stop surface and/or of a blade root flank, the micro-alloyed region being alloyed with at least one element selected from niobium, tantalum, molybdenum, tungsten, platinum, rhenium.

11. The component of claim 10, wherein the plating comprises a cobalt-base alloy.

12. A process for producing a component for a turbomachine, in which process there is provided a component comprising at least one region made of an intermetallic material which is formed from an intermetallic compound or comprises an intermetallic phase as largest constituent and wherein microplasticization is carried out in the intermetallic material at least partially at a surface or interface in a region close to the surface or interface.

13. The process of claim 12, wherein the microplasticization is effected thermally and/or mechanically.

14. The process of claim 12, wherein the microplasticization is carried out as high-speed microplasticization.

15. The process of claim 12, wherein the microplasticization is effected by micropeening.

16. The process of claim 15, wherein the microplasticization is effected by ultrasonic peening.

17. The process of claim 12, wherein before the microplasticization, a plate or a coating in form of a powder, a film, a lacquer or a vapor-deposited layer is applied to a region subjected to the microplasticization.

18. The process of claim 17, wherein the plate is applied by ultrasonic welding.

19. A process for producing the component for a turbomachine according to claim 1, in which process there is provided a component comprising at least one region made of an intermetallic material which is formed from an intermetallic compound or comprises an intermetallic phase as largest constituent and wherein microplasticization is carried out in the intermetallic material at least partially at a surface or interface in a region close to the surface or interface.

Method for reinforcing components from a TiAl base material and corresponding components

DE102009032564

- **Patent Assignee**
  MTU AERO ENGINES
- **Inventor**
  JAKIMOV ANDREAS
  RICHTER KARL-HERMANN
- **International Patent Classification**
  B23K-009/04 B23K-026/14 B23K-026/34 B23K-035/30 B32B-015/01 C23C-004/00 C23C-028/00 F01D-005/28 F41H-005/02
- **CPC Code**
  B23K-009/04; B23K-026/144; B23K-026/32; B23K-026/342; B23K-026/34; B23K-035/30/33; B23K-035/30/46; B23K-035/30; B23K-035/34; B23K-2201/001; B23K-2203/08; B23K-2203/10; B23K-2203/14; B32B-015/01; C22C-019/03; C22C-019/07; C22C-027/06; F01D-005/22/5; F01D-011/02; F05C-2201/0463; F05C-2201/0466; F05D-2300/506; F05D-2300/702; Y02T-050/671
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  2009DE-10032564 2009-07-10

- **Fampat family**

DE102009032564	A1	2011-01-13	[DE102009032564]
EP2275220	A1	2011-01-19	[EP2275220]

- **Abstract:**
  (EP2275220)
  The method for plating components made of a basic material (10), comprises applying an intermediate layer (11) made of nickel alloy onto the basic material by cold gas spraying process, and applying a plating (12) onto the intermediate layer by laser pulse deposition welding, where the plating is applied with nickel-basis-superalloy, cobalt-basis-superalloy and/or cobalt-chromium-alloy. The welding temperature during deposition welding is selected, so that only the intermediate layer partially melts but not the component. The intermediate layer contains melt-weldable nickel-wrought alloy. The method for plating components made of a basic material (10), comprises applying an intermediate layer (11) made of nickel alloy onto the basic material by a cold gas spraying process, and applying a plating (12) onto the intermediate layer by a laser pulse deposition welding, where the plating is applied with nickel-basis-superalloy, cobalt-basis-superalloy and/or cobalt-chromium-alloy. The welding temperature during the deposition welding is selected, so that only the intermediate layer partially melts but not the component. The intermediate layer contains a melt-weldable nickel-wrought alloy and/or is applied with a thickness of 0.3-1 mm, the plating is deposited with a layer thickness of 1-2 mm and/or the basic material is made of titanium aluminide, titanium aluminum or their alloy. An independent claim is included for a component.

Claims

(EP2275220)

Claims machine translated from German

1. Process for plating of components of a base material, which mainly comprises titanium and aluminum,
wherein
applied to the base material (10) an intermediate layer of a Ni-alloy and is provided on the intermediate layer (11) Armor (12).
2. The method of claim 1,
wherein
the armor with a Ni-based super alloy, Co-based super alloy and / or Co-Cr alloy is applied.
3. The method of claim 1 or 2,
wherein
the intermediate layer (11) is applied by cold gas spraying.
4. The method of claim,
wherein
the armor (12) is applied by welding.
5. The method of claim 4,
wherein
the armor (12) by laser powder cladding is applied.
6. The method of claim 4 or 5,
wherein
the welding temperature during the coating is selected so that only the intermediate layer (11) partially melted, but not the component.
7. The method of claim,
wherein
the intermediate layer (11) has a melt-weldable Ni-alloy covers and / or with a thickness of 0.2 to 1.5 mm, particularly 0.3 to 1 mm is applied and / or the armor (12) with a layer thickness of 0, 5 to 2.5 mm, especially 1 to 2 mm is deposited and / or the base material (10) made of a titanium aluminide, TiAl, Ti [3] Al, TiAl [3] or an alloy formed thereof.
8. Component of a base material (10), largely comprising titanium and aluminum,
characterized by
an armor (12) and an intermediate layer (11), which is located between armor and base material and is formed from a Ni-alloy.
9. Component according to claim 8,
wherein
the armor on a Ni-based super alloy, Co-based super alloy and / or Co-Cr alloy.
10. Component according to claim 8 or 9,
wherein
the intermediate layer (11) has a thickness of 0.2 to 1.5 mm, in particular from 0.3 to 1 mm.
11. Component according to claims 8 to 10,
wherein
the armor (12) a layer thickness of 0.5 to 2.5 mm, in particular from 1 to 2 mm.
12. Component according to claims 8 to 11,
wherein
the intermediate layer (11) has a melt-weldable Ni-alloy covers.
13. Component according to claims 8 to 12,
wherein
the base material (10) of a titanium aluminide, TiAl, Ti [3] Al, TiAl [3] or an alloy is formed from it.
14. Component according to claims 8 to 13,
wherein
the component is a turbine blade (1), particularly low-pressure turbine blade.
15. Component according to claims 8 to 14,
wherein
the armor (12) on a wear surface of a cover band (2), and a Z-score (5.6) is located.

Method for producing forged components from a tial alloy and component produced thereby

DE102012201082

- **Patent Assignee**
  MTU AERO ENGINES
- **Inventor**
  SMARSLY WILFRIED
- **International Patent Classification**
  B21J-005/00 C21D-001/00 C22C-014/00 C22C-021/00 C22C-030/00 C22F-001/00 C22F-001/18 F01D-005/28 F01D-009/02
- **US Patent Classification**
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- **CPC Code**
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  2013WO-DE00037 2013-01-19

- **Fampat family**

DE102012201082	A1	2013-07-25	[DE102012201082]
WO2013110260	A1	2013-08-01	[WO2013110260]
EP2807281	A1	2014-12-03	[EP2807281]
US2014369822	A1	2014-12-18	[US20140369822]

- **Abstract:**
  (US20140369822)
  The invention relates to a method for producing a component from a TiAl alloy, wherein the component is shaped by forging, in particular isothermal forging, and is subsequently subjected to at least one heat treatment, wherein in the first heat treatment the temperature is between 1100 and 1200° C. and is maintained for 6 to 10 hours and then the component is cooled. (From US2014369822 A1)

Claims
(US20140369822)
16. A method for producing a component from a TiAl alloy, wherein the method comprises shaping the component by forging and subsequently subjecting the component to at least one heat treatment and wherein in a first heat treatment a temperature of from 1100 deg. C. to 1200 deg. C. is maintained for 6 to 10 hours, whereafter the component is cooled.
1.-15. (canceled)
17. The method of claim 16, wherein the component is cooled at a cooling rate of from 1 deg. C./s to 5 deg. C./s.
18. The method of claim 16, wherein the method further comprises a second heat treatment.
19. The method of claim 18, wherein in the second heat treatment the component is heated to a temperature above a solvus line of gamma -TiAl.
20. The method of claim 19, wherein after the second heat treatment the component is rapidly cooled by quenching in water or oil or by air cooling using a fin.
21. The method of claim 20, wherein after the second heat treatment the component is cooled so rapidly that a transformation of alpha -TiAl into a lamellar structure of alpha -TiAl and gamma -TiAl is suppressed.
22. The method of claim 18, wherein the temperature is maintained above the solvus line until a desired phase composition of alpha -TiAl and gamma -TiAl is achieved.
23. The method of claim 19, wherein during the second heat treatment the temperature is from 20 deg. C. to 50 deg. C. above the solvus line.
24. The method of claim 19, wherein during the second heat treatment the temperature is from 25 deg. C. to 35 deg. C. above the solvus line.
25. The method of claim 18, wherein the second heat treatment is carried out at a temperature below the gamma -TiAl -- phase field solvus line.
26. The method of claim 25, wherein the temperature is from 12 deg. C. to 18 deg. C. below the solvus line.
27. The method of claim 16, wherein the TiAl alloy comprises from 42 to 45 at. % Ti, from 3.5 to 4.5 at. % Nb, from 0.75 to 1.5 at. % Mo, and from 0.05 to 0.15 at. % B, remainder aluminum and unavoidable impurities.
28. The method of claim 27, wherein the TiAl alloy comprises from 42.5 to 44.5 at. % Ti, from 4 to 4.2 at. % Nb, from 0.9 to 1.2 at. % Mo, and from 0.1 to 0.12 at. % B.
29. The method of claim 16, wherein the component is shaped by isothermal forging.
30. The method of claim 16, wherein the component is shaped by investment casting and subsequent hot isostatic pressing.
31. The method of claim 18, wherein the method further comprises a third heat treatment for stabilization in a temperature range of from 800 deg. C. to 950 deg. C. for from 5 to 7 hours.
32. The method of claim 18, wherein the temperature during at least one heat treatment is set and maintained with an accuracy of a 5 deg. C. to 10 deg. C. upward and downward deviation from a desired temperature.
33. A component, wherein the component is obtained by the method of claim 16.
34. The component of claim 33, wherein the component is a component of a turbomachine.
35. The component of claim 34, wherein the component is a rotor blade, a guide vane or a turbine blisk.

Method for hardfacing the z-notch of tial blades
DE102011087158

- **Patent Assignee**
  MTU AERO ENGINES
- **Inventor**
  DANIELS BERND
  HANRIEDER HERBERT
  RICHTER KARL-HERMANN
  STRASSER MICHAEL
- **International Patent Classification**
  B22F-007/04 B22F-007/08 B23K-001/00 C23C-028/00 F01D-005/22 F01D-005/28
- **US Patent Classification**
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- **CPC Code**
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  2012WO-DE01067 2012-11-06

- **Fampat family**

DE102011087158	A1	2013-05-29	[DE102011087158]
WO2013075688	A1	2013-05-30	[WO201375688]
EP2783076	A1	2014-10-01	[EP2783076]
US2014342169	A1	2014-11-20	[US20140342169]

- **Abstract:**
  (US20140342169)
  A method for arranging a coating, in particular a hardfacing, on a component, in particular a TiAl drive unit component, is disclosed. The coating comprises a metallic coating material. A green body is formed with the coating material, which is arranged in the presence of a solder on the component and is formed into a coating by a combined solder-sintering process and is fixed on the component. (From US2014342169 A1)

Claims

(US20140342169)

14. A method for arranging a coating on a component, comprising the steps of: forming a green compact with a coating material;

arranging the green compact on the component in a presence of a solder;

forming the coating material into a coating and fixing the coating on the component by a combined solder-sintering process.

1.-13. (canceled)

15. The method according to claim 14, wherein the component is a TiAl engine part.

16. The method according to claim 14, wherein the solder is contained in the green compact.

17. The method according to claim 14, wherein the solder is contained in a slurry which includes a binding agent and/or a solvent.

18. The method according to claim 17, wherein the solder is contained in the slurry in a form of particles.

19. The method according to claim 17, wherein the binding agent and/or the solvent is an organic binding agent and/or solvent.

20. The method according to claim 14, wherein the green compact includes an adhesive and/or the component includes an adhesive.

21. The method according to claim 17, wherein prior to soldering, highly volatile constituents of the slurry are vaporized in a temperature range of 60 deg. C. to 500 deg. C.

22. The method according to claim 14, wherein the green compact has a thickness of 0.2 mm to 2 mm.

23. The method according to claim 14, wherein the solder-sintering process is carried out by inductive heating.

24. The method according to claim 14, wherein the solder-sintering process is carried out in a vacuum or under protective gas.

25. The method according to claim 14, wherein the coating material comprises a Co -- Cr alloy.

26. The method according to claim 14, wherein the coating material comprises a Co-based alloy with a Cr percentage of greater than 25% by weight and a W percentage of 4% to 20% by weight or with a Cr percentage of less than 20% by weight and a Mo percentage of greater than 20% by weight.

27. The method according to claim 14, wherein the solder is a nickel-based solder.

28. The method according to claim 14, wherein the green compact is a 3-layer or multi-layer soldering tape which contains a solder/coating material mixture in an intermediate layer and solder only in outer layers.

29. An engine component having a coating according to claim 14.

Armoring sealing fins of tial vanes by induction brazing hard-material particles WO201371909

• **Patent Assignee** **MTU AERO ENGINES** • **Inventor** DANIELS BERND RICHTER KARL-HERMANN • **International Patent Classification** B23K-001/00 B23K-001/002 C23C-028/00 F01D-005/00 F01D-005/22 F01D-005/28 F01D-009/04 • **US Patent Classification** PCLO=415200000 PCLX=228122100 • **CPC Code** B23K-001/00/18; B23K-001/002; C23C-024/10/3; F01D-005/22/5 F01D-005/22/5; F01D-005/28/8 F01D-005/28/8; F01D-009/04/1;	• **Publication Information** **WO2013071909 A1 2013-05-23 [WO201371909]** • **Priority Details** 2011DE-10086524 2011-11-17 2012WO-DE01068 2012-11-06

• **Fampat family**

WO2013071909	A1	2013-05-23	[WO201371909]
DE102011086524	A1	2013-05-23	[DE102011086524]
EP2780552	A1	2014-09-24	[EP2780552]
US2014308117	A1	2014-10-16	[US20140308117]

• **Abstract:**
(US20140308117)
A method for armoring TiAl vanes of turbomachines is disclosed. A TiAl vane is provided onto which a mixture of at least one hard material and at least one braze material is applied so that subsequently the mixture can be brazed on the TiAl vane by an inductive heating process. A TiAl vane for a turbomachine, in particular for an aircraft engine, is also disclosed. The TiAl vane includes a TiAl main part and an armor which consists of a mixture of hard materials and braze material. (From US2014308117 A1)

Claims

(US20140308117)

15. A method of armoring a TiAl vane of a turbomachine, comprising the steps of: applying a mixture of a hard material and a braze material to the TiAl vane; and

brazing the mixture on the TiAl vane by an inductive heating process, wherein the braze material is a Ni-based braze material.

1.-14. (canceled)

16. The method according to claim 15, wherein the mixture is applied to a sealing fin of the TiAl vane.

17. The method according to claim 15, wherein the hard material is aluminum oxide, boron nitride, cubic boron nitride, titanium nitride, silicon carbide, tungsten carbide or titanium carbide.

18. The method according to claim 15, wherein the mixture has a ratio of 1:1 to 9:1 between the hard material and the braze material.

19. The method according to claim 15, wherein the mixture has a form of a brazing tape, a pre-sintered brazing preform, or a brazing paste.

20. The method according to claim 19, wherein the pre-sintered brazing preform or the brazing tape is fixed on the TiAl vane prior to the brazing by an adhesive or by welding.

21. The method according to claim 19, wherein the brazing paste includes an organic binder and is applied to the TiAl vane by brushing or imprinting.

22. The method according to claim 21, wherein the organic binder is a proportion of 5% by weight to 30% by weight of a total weight of the brazing paste.

23. The method according to claim 15, wherein a temperature of the brazing is in a range of 900 deg. C. to 1100 deg. C.

24. The method according to claim 15, wherein a hold time at which the mixture is kept at a brazing temperature is in a range of 30 seconds to 10 minutes.

25. The method according to claim 15, further comprising the step of cooling the brazed mixture with a cooling rate in a range of 10 deg.
Kelvin/minute to 100 deg.
Kelvin/minute.

26. A TiAl vane for a turbomachine, comprising: a TiAl main part; and

an armoring on the TiAl main part, wherein the armoring includes a mixture of a hard material and a braze material, wherein the braze material is selected from the group consisting of Ni-based braze materials AMS47XX, ASM4775, ASM4776, ASM4777, ASM4778, ASM4779 and ASM4782, and wherein the hard material is selected from the group consisting of aluminum oxide, boron nitride, cubic boron nitride, silicon carbide and titanium carbide.

27. The TiAl vane according to claim 26, wherein the mixture has a ratio of 1:1 to 9:1 between the hard material and the braze material.

28. The TiAl vane according to claim 26, wherein the armoring is on a sealing fin of the TiAl vane.

Method for producing low-pressure turbine blades from tial
WO2013152750

- **Patent Assignee**
  MTU AERO ENGINES
- **Inventor**
  RICHTER KARL-HERMANN
  HANRIEDER HERBERT
- **International Patent Classification**
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- **US Patent Classification**
  PCLO=219601000
- **CPC Code**
  B22F-003/105/5; B22F-005/04; B23K-026/00/06; B23K-026/00/15; B23K-026/00/18; B23K-026/00/81; B23K-026/12/3; B23K-026/421; B23K-026/60; B23K-2203/08; B33Y-010/00; F01D-005/00/5; F05D-2220/3215; F05D-2230/31; Y02P-010/295

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- **Fampat family**

WO2013152750	A1	2013-10-17	[WO2013152750]
DE102012206125	A1	2013-10-17	[DE102012206125]
EP2836322	A1	2015-02-18	[EP2836322]
US2015129583	A1	2015-05-14	[US20150129583]

- **Abstract:**
  (US20150129583)
  The invention relates to a method for producing a low-pressure turbine blade from a TiAl material by means of a selective laser melting process, wherein during production in the selective laser melting process the already partially manufactured low-pressure turbine blade is preheated by inductive heating, and wherein the selective laser melting process is carried out under protective gas, the protective gas atmosphere containing contaminants of oxygen, nitrogen, and water vapor in each case of less than or equal to 10 ppm. (From US2015129583 A1)

Claims

(US20150129583)

11. A method for producing a low-pressure turbine blade from a TiAl material by selective laser melting, wherein the method comprises preheating, during production by selective laser melting, an already partially produced low-pressure turbine blade by inductive heating, and carrying out the selective laser melting under an atmosphere of shielding gas contaminated with not more than 10 ppm of each of oxygen, nitrogen and water vapor.

1-10. (canceled)

12. The method of claim 11, wherein the shielding gas is contaminated with not more than 5 ppm of each of oxygen, nitrogen and water vapor.

13. The method of claim 11, wherein the shielding gas is purified upon, or just before, introduction into a process space for the selective laser melting.

14. The method of claim 11, wherein helium is used as the shielding gas.

15. The method of claim 11, wherein the shielding gas is provided with a pressure of from 50 to 1100 mbar in a process space for the selective laser melting.

16. The method of claim 15, wherein the shielding gas is provided with a pressure of from 100 to 1000 mbar.

17. The method of claim 11, wherein the TiAl material for the selective laser melting is used in the form of a powder with a grain size distribution having a maximum between 20 mu m and 50 mu m.

18. The method of claim 11, wherein a high-purity TiAl powder is used for the selective laser melting.

19. The method of claim 18, wherein the high-purity TiAl powder has been produced by an EIGA (Electrode Induction Melting Gas Atomization) method.

20. The method of claim 11, wherein a plurality of low-pressure turbine blades are produced simultaneously in a process space by selective laser melting.

21. The method of claim 11, wherein the temperature of each low-pressure turbine blade is monitored during the production by selective laser melting.

22. The method of claim 21, wherein a result of temperature monitoring supplied to a control and/or regulating unit for controlling and/or regulating an induction coil for the inductive heating.

23. The method of claim 11, wherein after the selective laser melting, the low-pressure turbine blade is subjected to hot isostatic pressing and/or a heat treatment.

24. The method of claim 11, wherein after the selective laser melting or hot isostatic pressing, the low-pressure turbine blade is not subjected to any further post-treatment, with the exception of a surface treatment by polishing.

25. A method for producing a low-pressure turbine blade from a TiAl material by selective laser melting, wherein the method comprises preheating, during production by selective laser melting, an already partially produced low-pressure turbine blade by inductive heating, and carrying out the selective laser melting under an atmosphere of helium contaminated with not more than 5 ppm of each of oxygen, nitrogen and water vapor.

26. The method of claim 25, wherein the helium is provided with a pressure of from 100 to 1000 mbar.

27. The method of claim 25, wherein the TiAl material for the selective laser melting is used in the form of a powder with a grain size distribution having a maximum between 20 mu m and 50 mu m.

28. The method of claim 27, wherein a high-purity TiAl powder is used for the selective laser melting.

29. The method of claim 28, wherein the high-purity TiAl powder has been produced by an EIGA (Electrode Induction Melting Gas Atomization) method.

30. The method of claim 25, wherein after the selective laser melting, the low-pressure turbine blade is subjected to hot isostatic pressing and/or a heat treatment.

High temperature TiAl alloy
US20150218675

• **Patent Assignee** **MTU AERO ENGINES** • **Inventor** SCHLOFFER MARTIN • **International Patent Classification** B22D-021/02 B22D-027/04 C22C-001/00 C22C-001/04 C22C-014/00 C22C-027/02 C22C-030/00 C22F-001/18 • **US Patent Classification** PCLO=420418000 PCLX=164047000 PCLX=164122200 PCLX=419061000 PCLX=420580000 • **CPC Code** B22D-021/02/2; B22D-027/04/5; C22C-001/00; C22C-001/04/58; C22C-001/04/91; C22C-014/00; C22C-027/02; C22C-030/00; C22F-001/18/3	• **Publication Information** US2015218675 **A1 2015-08-06 [US20150218675]** • **Priority Details** 2014EP-0154052 2014-02-06

• **Fampat family**

US2015218675	A1	2015-08-06	[US20150218675]
EP2905350	A1	2015-08-12	[EP2905350]

• **Abstract:**
(US20150218675)
The present invention relates to a TiAl alloy for use at high temperatures having the main constituents titanium and aluminum and having a proportion of aluminum of greater than or equal to 30 at. % and a matrix composed of phase and precipitates of phase embedded in the matrix, with the phase and the phase together making up at least 55% by volume of the microstructure, and also a process for the production thereof and the use thereof. (From US2015218675 A1)

Claims

(US20150218675)

16. A TiAl alloy for use at high temperatures, wherein the alloy comprises titanium and aluminum as main constituents, a proportion of aluminum being greater than or equal to 30 at. %, and further comprises a matrix of beta phase and precipitates of omega phase embedded in the matrix, the beta phase and the omega phase together making up at least 55% by volume of a microstructure of the alloy.

1-15. (canceled)

17. The TiAl alloy of claim 16, wherein the beta phase and the omega phase together make up at least 75% by volume of the microstructure.

18. The TiAl alloy of claim 16, wherein the beta phase and the omega phase together make up at least 80% by volume of the microstructure.

19. The TiAl alloy of claim 16, wherein the beta phase and the omega phase are present in the microstructure in a volume ratio of greater than 1:4 and less than 4:1, relative to one another.

20. The TiAl alloy of claim 19, wherein the beta phase and the omega phase are present in a volume ratio of greater than 1:3 and less than 3:1.

21. The TiAl alloy of claim 16, wherein the beta phase comprises morphologies of the beta phase, in particular beta or beta 0, and/or morphologies of the omega phase, in particular omega 0-B82, omega -D82 or omega '' transition phases.

22. The TiAl alloy of claim 16, wherein the omega phase is present with grain sizes ranging from 5 nm to 500 nm.

23. The TiAl alloy of claim 22, wherein the omega phase is present with grain sizes ranging from 10 nm to 450 nm.

24. The TiAl alloy of claim 16, wherein the omega phase is present in the microstructure with grain sizes in at least two different grain size ranges, a first grain size range encompassing grain sizes from 5 nm to 100 nm and a second grain size range encompassing grain sizes from 200 nm to 500 nm.

25. The TiAl alloy of claim 16, wherein the omega phase is present as spherical or cubic precipitates in the beta phase and/or as semicoherent precipitate in the beta matrix and/or as globular precipitate at grain boundries.

26. The TiAl alloy of claim 16, wherein the beta matrix has a network-like microstructure.

27. The TiAl alloy of claim 16, wherein the alloy comprises one or more alloying elements selected from Nb, Mo, W, Zr, V, Y, Hf, Si, C, and Co.

28. The TiAl alloy of claim 27, wherein the alloy comprises Nb and Mo, with proportions of these alloying elements in at. % of from 1.8:1 to 5:1.

29. The TiAl alloy of claim 28, wherein the alloy comprises Nb and Mo, with proportions of these alloying elements in at. % of from 2:1 to 3:1.

30. The TiAl alloy of claim 27, wherein the alloy comprises at least one element selected from W, Zr, V, Y, and Hf, which elements can be at least partly interchanged, and/or the alloy comprises at least one element selected from W, V, and Co, which elements can be at least partly interchanged.

31. The TiAl alloy of claim 27, wherein the alloy comprises at least one element selected from Zr, Y, and Hf, which elements can be at least partly interchanged.

32. The TiAl alloy of claim 16, wherein the alloy comprises: from 30 to 42 at. % of Al

from 5 to 25 at. % of Nb

from 2 to 10 at. % of Mo

from 0.1 to 10 at. % of Co

from 0.1 to 0.5 at. % of Si

from 0.1 to 0.5 at. % of Hf,

balance Ti.

33. The TiAl alloy of claim 16, wherein the alloy comprises: from 30 to 35 at. % of Al

from 15 to 25 at. % of Nb

from 5 to 10 at. % of Mo

from 5 to 10 at. % of Co

from 0.1 to 0.5 at. % of Si

from 0.1 to 0.5 at. % of Hf,

balance Ti.

34. A process for producing the TiAl alloy of claim 16, wherein the process comprises producing the alloy pyrometallurgically and drawing it as a single crystal or casting it to form a polycrystalline product or comprises producing the alloy at least partly powder-metallurgically.

35. A component of a flow machine, wherein the component comprises the alloy of claim 16.

Creep-resistant TiAl alloy
EP2851445

- **Patent Assignee**
  MTU AERO ENGINES
- **Inventor**
  SMARSLY WILFRIED DR
  CLEMENS HELMUT PROF DR
  SCHWAIGHOFER EMANUEL
- **International Patent Classification**
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- **US Patent Classification**
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- **CPC Code**
  C22C-001/02 C22C-001/02; C22C-014/00; C22F-001/00/2; C22F-001/18/3; F05D-2300/133 F05D-2300/133;
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  2013EP-0185280 2013-09-20

- **Fampat family**

EP2851445	A1	2015-03-25	[EP2851445]
US2015086414	A1	2015-03-26	[US20150086414]

- **Abstract:**
  (US20150086414)
  Disclosed is a TiAl alloy for high-temperature applications which comprises not more than 43 at. % of Al, from 3 at. % to 8 at. % of Nb, from 0.2 at. % to 3 at. % of Mo and/or Mn, from 0.05 at. % to 0.5 at. % of B, from 0.1 at. % to 0.5 at. % of C, from 0.1 at. % to 0.5 at. % of Si and Ti as balance. Also disclosed is a process for producing a component made of this TiAl alloy and the use of corresponding TiAl alloys in components of flow machines at operating temperatures up to 850° C. (From US2015086414 A1)

Claims

(US20150086414)

What is claimed is:

1.

A TiAl alloy for high-temperature applications, wherein the alloy comprises: not more than 43 at. % of Al,

from 3 at. % to 8 at. % of Nb,

from 0.2 at. % to 3 at. % of Mo and/or Mn,

from 0.05 at. % to 0.5 at. % of B,

from 0.1 at. % to 0.5 at. % of C,

from 0.1 at. % to 0.5 at. % of Si and

Ti as balance.

2. The TiAl alloy of claim 1, wherein the alloy comprises: not more than 43 at. % of Al,

from 3.5 at. % to 4.5 at. % of Nb,

from 0.8 at. % to 1.2 at. % of Mo and/or Mn,

from 0.05 at. % to 0.15 at. % of B,

from 0.2 at. % to 0.4 at. % of C,

from 0.2 at. % to 0.4 at. % of Si and

Ti as balance.

3. The TiAl alloy of claim 1, wherein the alloy comprises: 43 at. % of Al,

4 at. % of Nb,

1 at. % of Mo,

0.1 at. % of B,

0.3 at. % of C,

0.3 at. % of Si and

Ti as balance.

4. The TiAl alloy of claim 1, wherein the alloy comprises gamma -TiAl, alpha 2-Ti3Al and beta o/B2-Ti at room temperature.

5. The TiAl alloy of claim 2, wherein the alloy comprises gamma -TiAl, alpha 2-Ti3Al and beta o/B2-Ti at room temperature.

6. A process for producing a component made of the TiAl alloy of claim 1, wherein the process comprises subjecting a cast and/or cold- and/or hot-formed intermediate product to a heat treatment which comprises annealing at a temperature of from about 800 deg. C. to about 900 deg. C. for from about 4 to about 8 hours.

7. The process of claim 6, wherein annealing takes place at a temperature of or about 850 deg. C. for about 6 hours.

8. The process of claim 6, wherein annealing is ended by rapid cooling.

9. The process of claim 7, wherein annealing is ended by rapid cooling.

10. The process of claim 6, wherein the heat treatment is carried out in two stages, and annealing represents a second stage of the heat treatment.

11. The process of claim 10, wherein annealing is preceded by aging as first stage of the heat treatment.

12. The process of claim 11, wherein aging takes place at a temperature of from about 950 deg. C. to about 1300 deg. C. for from about 0.1 hour to about 2 hours.

13. The process of claim 11, wherein aging takes place at a temperature of from about 950 deg. C. to about 1050 deg. C. or at a temperature from about 1200 deg. C. to about 1300 deg. C. for from about 0.25 hour to about 1 hour.

14. The process of claim 7, wherein the heat treatment is carried out in two stages, and annealing represents a second stage of the heat treatment.

15. The process of claim 14, wherein annealing is preceded by aging as first stage of the heat treatment.

16. The process of claim 15, wherein aging takes place at a temperature of from about 950 deg. C. to about 1300 deg. C. for from about 0.1 hour to about 2 hours.

17. The process of claim 15, wherein aging takes place at a temperature of from about 950 deg. C. to about 1050 deg. C. or at a temperature from about 1200 deg. C. to about 1300 deg. C. for from about 0.25 hour to about 1 hour.

18. A component of a flow machine, wherein the component comprises the TiAl alloy of claim 1.

19. The component of claim 18, wherein the component is for use at temperatures of up to about 850 deg. C.
20. The component of claim 18, wherein the component is for use at operating temperatures of from about 800 deg. C. to about 830 deg. C.

Heat-resistant TiAl alloy
EP2620517

- **Patent Assignee**
  MTU AERO ENGINES
- **Inventor**
  SMARSLY WILFRIED DR
  CLEMENS HELMUT PROF DR
- **International Patent Classification**
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- **CPC Code**
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  2012EP-0152427 2012-01-25

- **Fampat family**

EP2620517	A1	2013-07-31	[EP2620517]

- **Abstract:**
  (EP2620517)
  A heat-resistant titanium alloy comprises 43-45 atomic% molybdenum, 0.5-3 atomic% niobium, 0-4.9 atomic% vanadium, chromium, manganese and iron, 0-0.5 atomic% zirconium and hafnium, 0.1-1 atomic% carbon, 0.05-0.2 atomic% boron and 0-1 atomic% silicon, and remaining aluminum and titanium. The composition is selected such that the precipitation of titanium-rich carbide precipitates and solidification of carbon in the mixed crystals of the alloy are eliminated. An independent claim is included for manufacture of the alloy.

Claims

(EP2620517)

Claims machine translated from German

1. Alloy on the Basis characterized by [TiAl], which covers other .beta.-stabilizing Elements beside unavoidable Impurities as Alloying Constituents Titanium, Aluminum, 43-45 [at]%, Molybdenum, 0.5 -3%, such as Niobium, 0 -4.9 [at]%, Vanadium, Chrome, Manganese, Iron in Sum 0-5 [at]%, [Sonderkarbidbildner] Hf us [Zr], in Sum 0-0.5 RKs ***%sowie Carbon, 0.1-1 RKs %, and Boron 0.05 -0.2 [at]%, and Silicon 0 -1 [at]%, by the fact that
the Composition so selected is that under large Avoidance of titanium-rich carbide eliminations Carbon is solved in the Mixed Crystals of the Alloy and the Solidification of the Alloy from the Melt is made exclusively by liquation and texture-poor .beta.-phase, what a noticeable Purifying of the Casting Structure to the Consequence has.
By purposeful Thermal Treatments very fine Special Carbides on the Basis of e.g. can.
Hafnium and Zircon to be ruled out.
2. Like 1 only with a small Content of rare earth elements, in Sum to 1 [at]% (e.g. Yttrium, Lanthan, Gadolinium)
3. Alloy after one of the preceding claims,
by the fact characterized that
the Structure as fine-grained laminated Structure is adjusted, with which .gamma. and .alpha. [2] - Phase in Lamella Colonies with an average Colony Size of under 200 ***.micro.m Diameters, in particular smaller 50 ***.micro.m Diameters are present.
Additionally [globulare] can be stored .gamma. and/or .beta. [o] - Grains into the laminated Matrix
4. Alloy after one of the preceding claims,
by the fact characterized that the Alloy Boron with a Portion of in particular with 0,1 to 0.15 RKs. - % exhibits.
5. Alloy after one of the [vohergehenden] claims, by the fact characterized that the Alloy Silicon with a Portion from in particular 0.2 to 0.5 RKs. - % exhibits.
6. Alloy after one of the [vohergehenden] claims, by the fact characterized that the Alloy Yttrium, Lanthan and Rare of Earth Elements (SE) with a Total Portion from 0 to 1 RK. - % exhibits.
7. Alloy according to claim 1 to 6,
by the fact characterized that
the Composition of the Alloy is so selected that at a Temperature of more than 700.deg.C of the Formation of the .omega.-phase one minimizes or one suppresses
8. Procedure for the Production of an Alloy after one of the preceding claims with the following Steps:
- Production of a Melt,
- Solidifying the Melt in the [Ingot] and/or with the [Pulververdusung] exclusive over the .beta.-phase
- Attitude of a fine-grained laminated Structure, which [globulare] Structure Portions of the regulatory - .beta. [o] and to exhibit knows .gamma.-phase.
9. Procedure according to claim 8,
by the fact characterized that
the Melt produced by Vacuum Electric Arc Melting or Plasma Electric Arc Melting and/or the Shaping via Casting one takes place and/or the Structure Attitude via Thermal Treatment and/or thermalmechanical Treatment, in particular hot-isostatic Pressing, Extrusion, Smithies and Rollers takes place.
10. Procedure according to claim 1-9
by the fact characterized that Powder from Alloys is produced according to claim 1-10 by [Gasverdusung] and/or the Compression and Shaping via hot-isostatic Pressing, Extrusion, Smithies takes place and/or the Structure Attitude via Thermal Treatment takes place.
11. Procedure according to claim 1-10
by the fact characterized that Powder from Alloys is produced according to claim 1-10 by [Gasverdusung] and/or the Compression and Shaping via Lasers or Welding Of Structure Of Electron-beam and/or the Structure Attitude via Thermal Treatment takes place.
12. Alloy according to claim 1, by the fact characterized that one can use it as Cast Alloy, Smithy alloy and powder metallurgical manufactured Alloy. By appropriate in and/or multi-level Thermal Treatments can be implemented Cast Alloy, Smithy alloy and powder metallurgical manufactured Alloy either as high-temperature resistant "ceramic" Variant and/or as [duktile] "metallic" Variant.
13. Turbine Construction Part, in particular Direction or Rotor Blade of a Gas Turbine, with an Alloy after one of the claims 1 to 8, preferably manufactured with the Procedure after one of the claims 9 to 12.

Turbine blade, useful in fluid-flow machine e.g. stationary gas turbine or aircraft engine, comprises monocrystalline of titanium aluminide material in blade portion, and blade root made of polycrystalline material

DE102012222745

- **Patent Assignee**
  MTU AERO ENGINES
- **Inventor**
  ZENZINGER FLORIAN
  WERNER ANDRÉ DR
- **International Patent Classification**
  B22D-021/06 B23P-015/02 C22C-014/00 F01D-005/28
- **CPC Code**
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- **Priority Details**
  2012DE-10222745 2012-12-11

- **Fampat family**

DE102012222745	A1	2014-06-12	[DE102012222745]

- **Abstract:**
  (DE102012222745)
  Questel Machine translated AbstractThe present Invention concerns a Procedure for the Production of a single-crystal Turbine Blade for a Fluid-flow Machine, as for example a stationary Gas Turbine or an Aero Engine from a TiAl material, as well as an accordingly manufactured Turbine Blade (10).

Claims
(DE102012222745)

Claim machine translated from German
1. Turbine Blade for a Fluid-flow Machine from a TiAl material, by the fact characterized that the TiAl material is single-crystal at least in the Range of the Shovel Sheet (14).

Claims machine translated from German
1. Turbine Blade for a Fluid-flow Machine from a TiAl material, by the fact characterized that the TiAl material is single-crystal at least in the Range of the Shovel Sheet (14).
2. Turbine Blade according to claim 1, by the fact characterized that the TiAl material is a inter+metallic Phase.
3. Turbine Blade according to claim 1 or 2, by the fact characterized that the TiAl material is an Alloy on Basis of the .gamma.-phase.
4. Turbine Blade after one of the preceding claims, by the fact characterized that the TiAl material is an Alloy with Niobium and Molybdenum.
5. Turbine Blade after one of the preceding claims, by the fact characterized that the Blade Root (12) is trained polycrystalline.
6. Procedure for the Production of a Turbine Blade after one of the preceding claims, whereby the TiAl material into a Form (2) is poured and is single-crystal solidified.
7. Procedure according to claim 6, by the fact characterized that the Form a Crystal Lector (5) and the Form exhibits in the Bridgeman procedure from a Heating Zone, in which the Material is present liquid, into a Solidification Zone is moved, so that itself a Solidification Front (8) moved by the Form, whereby Rate Of Motion is selected in such a way that a single-crystal Growth is made possible.
8. Procedure according to claim 6 or 7, by the fact characterized that the Form (2) while the Movement from the Heating Range into the Solidification Range is linear moved and around the linear Direction Of Movement is turned.
9. Procedure after one of the claims 6 to 8, by the fact characterized that Rate Of Motion is changed in such a way in the Transition of the Shovel Sheet (14) to the Blade Root (12) or within the Range of the Blade Root that the Solidification from single-crystal changes to polycrystalline.
10. Procedure after one of the claims 7 to 9, by the fact characterized that the Form (2) is so trained and from the Heating Zone is moved in such a way that itself the Solidification Front (8) of the Shovel Point moved toward the Blade Root.
11. Procedure after one of the claims 6 to 10, by the fact characterized that the Casting Process on Vacuum Conditions is accomplished.

Method for producing TiAl components
EP2990141

- **Patent Assignee**
  MTU AERO ENGINES
- **Inventor**
  SCHLOFFER MARTIN
  SMARSLY WILFRIED
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US2016059312	A1	2016-03-03	[US20160059312]

- **Abstract:**
  (US20160059312)
  The present invention relates to a process for producing a component, in particular a component for a turbomachine, composed of a TiAl alloy, which comprises the following: introduction of a powder of the TiAl alloy into the capsule whose shape corresponds to the shape of the component to be produced and closing of the capsule, hot isostatic pressing of the capsule together with the powder, heat treatment of the hot isostatically pressed capsule, removal of the capsule, post-working of the contour of the component by removal of material.
  (From US2016059312 A1)

Claims

(US20160059312)

What is claimed is:

1.

A process for producing a component of a TiAl alloy, wherein the process comprises: introduction of a powder of the TiAl alloy into a capsule whose shape corresponds to a shape of the component to be produced and closing of the capsule,

hot isostatic pressing of the capsule together with the powder,

heat treatment of the hot isostatically pressed capsule,

removal of the capsule,

post-working of a contour of the component by removal of material.

2. The process of claim 1, wherein the powder has been produced by a process which comprises at least one of the following: pressing of starting materials or melting of prealloys which consist of or comprise the components to be alloyed,

melting of the alloy by one or more of single or multiple plasma arc melting (PAM), vacuum arc remelting (VAR), vacuum induction melting (VIM),

atomization of the alloy to produce the powder from a melt bath or with the aid of a cast ingot,

classification of powder fractions and selection of one or more powder fractions having average or maximum particle diameters or maximum dimensions smaller than or equal to 150 mu m, and

purification of the powder in a plasma purification process.

3. The process of claim 1, wherein the capsule is formed of titanium or a Ti alloy.

4. The process of claim 1, wherein the capsule is formed by at least two shaped parts.

5. The process of claim 1, wherein the capsule is overdimensioned relative to the component to be produced.

6. The process of claim 1, wherein the introduction of the powder is carried out under protective gas or under reduced pressure.

7. The process of claim 1, wherein the powder before introduction into the capsule or a filled but not yet closed capsule is subjected to a heat treatment under reduced pressure.

8. The process of claim 7, wherein cooling after the heat treatment is carried out at a cooling rate of from 25 deg. C./min to 35 deg. C./min down to a temperature of 120 deg. C. or less.

9. The process of claim 1, wherein a packing density of the powder in the capsule is increased by mechanical excitation before or after closing of the capsule.

10. The process of claim 1, wherein the hot isostatic pressing is carried out in a temperature range of from 1100 deg. C. to 1400 deg. C. at a pressure of from 100 to 250 MPa for from 2 to 6 hours.

11. The process of claim 1, wherein a heat treatment is carried out after the hot isostatic pressing.

12. The process of claim 11, wherein the heat treatment comprises at least one of the following: a solution heat treatment at a temperature of up to 1400 deg. C. for from 15 to 45 minutes,

a high-temperature heat treatment at a temperature of from 1100 deg. C. to 1300 deg. C. for from 15 to 120 minutes and

an aging heat treatment at a temperature of from 850 deg. C. to 1100 deg. C. for from 6 to 100 hours.

13. The process of claim 1, wherein a net-shape component or near-net-shape component is produced by the hot isostatic pressing.

14. The process of claim 1, wherein the removal of the capsule is effected by at least one of chemical pickling, electrochemical treatment, mechanical working.

15. The process of claim 1, wherein the post-working of the contour is carried out by cutting machining and/or by electrochemical treatment.

16. The process of claim 1, wherein the process further comprises providing the component with one or more functional layers.

17. The process of claim 1, wherein the process further comprises characterizing the component and/or the material from which the component has been produced.

18. The process of claim 1, wherein the alloy comprises one or more elements from the group Nb, Mo, W, Co, Cr, V, Zr, Si, C, Er, Gd, Hf, Y, B.

19. The process of claim 1, wherein the alloy comprises Ti and Al as main constituents together with the following elements in the following proportions:

Wfrom 0 to 3 at. % and/orSifrom 0.2 to 0.35 at. % and/orCfrom 0 to 0.6 at. % and/orZrfrom 0 to 6 at. % and/orYfrom 0 to 0.5 at. % and/orHffrom 0 to 0.3 at. % and/orErfrom 0 to 0.5 at. % and/orGdfrom 0 to 0.5 at. % and/orBfrom 0 to 0.2 at. % and/orNbfrom 4 to 25 at. % and/orMofrom 1 to 10 at. % and/orWfrom 0.5 to 3 at. % and/orCofrom 0.1 to 10 at. % and/orCrfrom 0.5 to 3 at. % and/orVfrom 0.5 to 10 at. %.

20. A component made by the process of claim 1.

Al-RICH HIGH-TEMPERATURE TiAl ALLOY
US20160010184

- **Patent Assignee**
  MTU AERO ENGINES
- **Inventor**
  SMARSLY WILFRIED
  SCHLOFFER MARTIN
  CLEMENS HELMUT
  MAYER SVEA
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- **Abstract:**
  (US20160010184)
  The present invention relates to a TiAl alloy for use at high temperatures which has aluminum and titanium as main constituents. The TiAl alloy has an aluminum content of greater than or equal to 50 at. % and a matrix of -TiAl and at least one phase of Al and Ti incorporated in the -TiAl matrix which is different from -TiAl, as well as depositions of oxides and/or carbides and/or silicides. In addition, the invention relates to a method for producing the alloy and to the use of the alloy for components of turbo-machines, in particular aircraft engines.

Claims

(US20160010184)

What is claimed is:

1.

A TiAl alloy for use at high temperatures, wherein the alloy comprises aluminum and titanium as main constituents, has an aluminum content of greater than or equal to 50 at. %, and comprises a matrix of gamma -TiAl and at least one phase of Al and Ti incorporated in the gamma -TiAl matrix which is different from gamma -TiAl and comprises Al and Ti, as well as depositions of oxides and/or carbides and/or silicides.

2. The TiAl alloy of claim 1, wherein the alloy comprises up to 75 at. % of aluminum.

3. The TiAl alloy of claim 1, wherein the alloy comprises up to 65 at. % of aluminum.

4. The TiAl alloy of claim 1, wherein the alloy comprises up to 60 at. % of aluminum.

5. The TiAl alloy of claim 1, wherein the gamma -TiAl matrix occupies at least 50 vol. % of a microstructure of the alloy.

6. The TiAl alloy of claim 1, wherein the gamma -TiAl matrix has a closed or net-like or globular structure.

7. The TiAl alloy of claim 1, wherein the phases of Al and Ti which are different from gamma -TiAl comprise beta -phase and/or one or more Al-rich intermetallic phases.

8. The TiAl alloy of claim 7, wherein the Al-rich intermetallic phases comprise at least one of Al3Ti and Al2Ti.

9. The TiAl alloy of claim 1, wherein the depositions comprise at least ZrO2 and/or Y2O3.

10. The TiAl alloy of claim 1, wherein the alloy comprises one or more of Nb, Mo, W, Co, Cr, V, Zr, Si, C, Er, Gd, Hf, Y, B.

11. The TiAl alloy of claim 1, wherein the alloy comprises the following elements in the indicated percentages:

Wfrom 0 to 3 at. %Si from 0.2 to 0.35 at. %Cfrom 0 to 0.6 at. %Zrfrom 0 to 6 at. %Yfrom 0 to 0.5 at. %Hffrom 0 to 0.3 at. %Erfrom 0 to 0.5 at. %Gdfrom 0 to 0.5 at. %Bfrom 0 to 0.2 at. %.

12. The TiAl alloy of claim 1, wherein the alloy comprises the following elements in the indicated percentages:

Nbfrom 4 to 25 at. %and/orMofrom 1 to 10 at. %and/orWfrom 0.5 to 3.0 at. %and/orCofrom 0.1 to 10 at. %and/orCrfrom 0.5 to 3.0 at. %and/orVfrom 0.5 to 10.0 at. %.

13. A method for producing the TiAl alloy of claim 1 or a component produced from the alloy, wherein the method comprises (i) producing the alloy by melt metallurgy and drawing it in monocrystalline form or casting it in polycrystalline form, or

(ii) producing the alloy at least partially by powder metallurgy.

14. The method of claim 13, wherein according to (ii) at least portions of alloying constituents are alloyed mechanically.

15. The method of claim 13, wherein the alloy is melted by arc melting in vacuo or under a protective gas atmosphere and/or is cast by centrifugal casting.

16. The method of claim 13, wherein the alloy is subjected to hot isostatic pressing and/or isothermal forging after it has been cast or produced by powder metallurgy.

17. The method of claim 13, wherein the method further comprises subjecting the alloy and/or a component produced from the alloy to a single- or multi-step heat treatment.

18. A component of a turbomachine, wherein the component comprises the alloy of claim 1.

19. The component of claim 18, wherein the component is an aircraft engine.