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TiAl-based alloy and a method of manufacturing a directional CN103789598

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- **Fampat family**

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- **Abstract:**
  (CN103789598)
  The invention discloses directional TiAl-based alloy and a preparation method thereof. According to the atomic percentage, TiAl alloy components are expressed as Ti-(40-50)Al-aNb-bCr-cMo-dV-eMn, wherein in the formula, a, b, c, d, e are atomic percentages, a+b+c+d+e is less than or equal to 10, and the balance is Ti. The method for preparing the columnar crystal TiAl-based alloy includes the following steps that mother alloy is smelted through vacuum induction suspension, and a mother alloy cast rod is prepared through vacuum suction casting; an optical floating zone crystal growth system is adopted, argon is used as protection gas, the flow speed is 3-3.6L/min, the width of a regional heating zone is 6-6.7mm, heat treatment is performed on the TiAl-based alloy cast rod, the heating temperature is controlled to be 1250-1350 DEG C, the drawing speed is in the range of 3-13 micrometers per second, and the columnar crystal TiAl-based alloy is prepared. Compared with a directional solidification technology, in the preparation method, peritectic reaction is omitted, and therefore peritectic segregation is avoided; the problem that refractory metal and alloy, such as tungsten and molybdenum, with direction tissue cannot be prepared through the direction solidification technology can also be solved.

Claims

(CN103789598)

1. A directional TiAl-based alloy, characterized in, terms of an atomic percent basis, the alloy composition as follows: Ti-(40-50) Al-aNb-bCr-cMo-dV-eMn, in the formula, a, b, c, d, e in atomic percent, a + b + c + d + e 10, with the balance being Ti.

2. Fprintf TiAl based alloy according to claim 1, characterized in, a, b, c, d, e at least two is not 0.

3. Fprintf TiAl based alloy according to claim 1, characterized in, a, b, c, d, e at least three is other than 0.

4. TiAl-based alloy method of preparing an oriented, characterized in, method comprising the steps of:

1st step: in accordance with the raw material alloy component ratio in the suspension smelting furnace in a vacuum induction melting the mother alloy;

2nd step: using a vacuum molding process of the method, TiAl alloy continuously cast rod was prepared;

3rd step: floating zone crystal growth system employing optical, 2nd step of the continuously cast rod is heat-treated produced in an alloy.

5. Fprintf TiAl-based alloy of the production method according to claim 4, characterized in, 1st step alloy composition as follows: Ti -(40-50) Al-aNb-bCr-cMo-dV-eMn, in the formula, a, b, c, d, e in atomic percent, a + b + c + d + e 10, with the balance being Ti.

6. Fprintf TiAl-based alloy of the production method according to claim 4, characterized in, 1st step of the water-cooled copper crucible by melting the master alloy, vacuum evacuated to 10-3Pa or less, backfilled with inert argon gas to atmospheric pressure, 24 kw power of smelting, melting time was 3 minutes, repeated 3 times to times before melting.

7. Fprintf TiAl-based alloy of the production method according to claim 4, characterized in, 2nd step is to use vacuum molding process of the master alloy continuously cast rod 4 of the quartz glass tube molding process molding, molding process was 0.03 mpa a pressure differential, using power is 20 kw.

8. Fprintf TiAl-based alloy of the production method according to claim 4, characterized in, 3rd step heat treatment process parameters are: at 1250-1300 °C, incubated for 2-5min, shielding gas to argon is 3-3 . 6L/min, traction bar turning speed of 20 rpm, draw rate of 3-13 m/s, heating and cooling rate was 276.4-276.6 K/s.

High-temperature high-strength TiAl-Nb monocrystal and preparation method thereof

CN104878452

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- **Fampat family**

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- **Abstract:**
(CN104878452)
The invention discloses a high-temperature high-strength TiAl-Nb monocrystal and a preparation method thereof. Based on the atomic percent, the high-temperature high-strength TiAl-Nb monocrystal comprises the alloy components: Ti-(43-47) Al-(6-10)Nb-(0.1-1)(C, Si), and the balance of Ti. The preparation method comprises the following steps: smelting TiAl-Nb button-shaped master alloy ingot casting by using an electro-magnetic induction suspension method; preparing a cylindrical rod-shaped sample by means of differential pressure suction casting or gravity casting; directionally condensing the cylindrical bar by using an optical float-zone crystal growth system to guarantee that the heating power is between 65% and 70%, the growth velocity is 5-30mm/h, the relative rotation speed is 20-40r/min and the argon flow protection is carried out for 3-5L/min; finally obtaining a TiAl-Nb monocrystal test bar; and performing desegregation heat treatment on the TiAl-Nb monocrystal bar to finally obtain the monocrystal test sample. By adopting the TiAl-Nb monocrystal alloy material prepared by using preparation method disclosed by the invention, the alloy pollution caused by a traditional Bridgman directional condensation method can be effectively avoided, a solid-liquid interface shape during condensation is controlled by regulating the heating power so as to quickly obtain the TiAl-Nb monocrystal, and after the desegregation of the TiAl-Nb monocrystal, the high-strength TiAl-Nb monocrystal alloy of which the yield strength is 637MPa at a temperature of 900 DEG C, the elongation percentage is 8.1% and the ductile-brittle transition temperature is not lower than 900 DEG C can be obtained.

Claims

(CN104878452)

1. A high temperature high strength TiAl-Nb single crystal, characterized in, in atomic percent, the alloy component is: Ti-(43-47) Al-(6-10) Nb-(0.1-1) (C, Si), balance Ti.

2. High-strength TiAl-Nb single crystal of the method according to claim 1, characterized in, comprising the steps of:

Weighing the raw materials in(1) atomic percent of the alloy, under an inert atmosphere, repeating the method using electromagnetic induction smelting button-like suspension smelting TiAl-Nb master alloy ingot;

A(2) differential pressure suction casting or gravity casting prepared TiAl-Nb round bar test pieces, and as a seed bar and the feeding stick;

Crystal growth system for floating the reformulated(3) TiAl-Nb round bar test pieces by directional solidification, the length 20 is lower-seed bar 30 mm, less than 190 mm of the length to the upper feeding stick, and the feeding stick necking crystal election processing; feeding rods with a seed rod directionally solidifying the first axis and perpendicular to the set level, with as a seed bar spacing 1 feeding stick-3 mm, and the interval at the four focusing filament center; 3 passing the flow-protected 5 L/min inert gas, and adjusting of the seed bar and the feeding stick to rotate in opposite directions, rotation speed of 20-40 r/min, 6 a -12min 65 up to within the power uniform-melting the alloy 70%; contact with the seed rod to adjust an rods, heat-5-10min when the floating zone is stable after, regulate the rate of 5-30 mm/h, the directional solidification, the crater end and then gradually reducing power, and the remaining feed bar while the solidified sample separated sample to perform;

The(4) TiAl-Nb despread a vacuum heat treated single crystal alloy segregation.

3. High-strength TiAl-Nb method of producing a single crystal according to claim 2, characterized in, step(1), not less than 4 times the number of melting.

4. A high-strength TiAl-Nb method for producing a single crystal according to claim 2, characterized in, step(2), when the differential pressure suction casting, maintained at 3 mpa pressure difference, gravity casting, a protective gas in two-thirds of normal atmospheric pressure; the prepared mother alloy round bar sample size (4-8) mm.

5. High-strength TiAl-Nb method of producing a single crystal according to claim 2, characterized in, step(3), the inert gas is argon or nitrogen.

6. High-strength TiAl-Nb method of preparing a single crystal according to claim 2, characterized in, step(4), the single-crystal ingot out of the vacuum heat "1250 °C x24h + 900 °C x30min + air cooling" de segregation processes processing.

TiAl-base alloy and heat treatment technique thereof
CN104480347

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- **Abstract:**
  (CN104480347)
  The invention discloses a TiAl-base alloy and a heat treatment technique thereof. The TiAl-base alloy is expressed as Ti-(40-50)Al-2Nb-2Cr-aV according to atomic percent, wherein a is atomic percent, and 0<a<=4; and the rest component is Ti. The method for preparing the TiAl-base alloy with fine crystal grain and uniform structure comprises the following steps: carrying out vacuum induction suspension smelting on mother alloy in a water-cooled copper crucible, putting the mother alloy in an HTF high-temperature electric resistance furnace, and carrying out heat treatment on the mother alloy in protective gas argon. The heat treatment technique comprises the following steps: annealing the mother alloy at 1310-1330 DEG C for 10-30 minutes, keeping the temperature at 1310-1330 DEG C for 10-30 minutes, and cooling in the furnace to room temperature. Compared with the existing heat treatment regime, the material does not need quenching in the heat treatment process, thereby avoiding microcracking; and the technique does not need any expensive hot working equipment, thereby lowering the cost and widening the application range of the TiAl-base alloy.

Claims

(CN104480347)

1. A TiAl-based alloy, characterized in, in atomic percentage, the following alloy components:
Ti-(40-50) Al -2Nb-2Cr-aV, a atomic percent, 0 a 4, balance Ti.

2. TiAl-based alloy according to claim 1, characterized in, TiAl based alloy prepared by:
1st step: the proportion of the components in the alloy material in the suspension smelting furnace into water-cooled copper crucible vacuum induction melting the mother alloy;
2nd step: using high temperature electric furnace HTF type, step 1st the master alloy is prepared to 1st heat treatment, heat treatment followed by furnace cooling to room temperature and subjected to 2nd heat treatment.

3. TiAl-based alloy according to claim 2, characterized in, step 1st of melting the mother alloy, vacuum suction to 10-3Pa or less, and filled with an inert gas of argon to atmospheric pressure, melting power 19-20 kW, smelting 2-3 min time, 3 times repeatedly melted, the molten alloy uniformly.

4. TiAl-based alloy according to claim 2, characterized in, in step 2nd, 1st 2nd and the heat treatment temperature of heat treatment are 1310-1330 °C, 1st 2nd and the heat treatment of the heat treatment is incubation period 10-30 min.

5. A heat treated alloy TiAl based processes, characterized in, the thermal processing comprises the steps of:
1st step: the proportion of the components in the alloy material in the suspension smelting furnace into water-cooled copper crucible vacuum induction melting the mother alloy;
2nd step: using high temperature electric furnace HTF type, step 1st the master alloy is prepared to 1st heat treatment, heat treatment followed by furnace cooling to room temperature and subjected to 2nd heat treatment.

6. Processing TiAl-based alloy is heat treated according to claim 5, characterized in, step 1st of melting the mother alloy, vacuum suction to 10-3Pa or less, and filled with an inert gas of argon to atmospheric pressure, melting power 19-20 kW, smelting 2-3 min time, 3 times repeatedly melted, the molten alloy uniformly.

7. TiAl based alloy heat treatment processes according to claim 5, characterized in, in step 2nd, 1st 2nd and the heat treatment temperature of heat treatment are 1310-1330 °C, 1st 2nd and the annealing heat treatment is incubation time are 10-30 min.

High-strength high-ductility TiAl alloy material and preparation method thereof
CN104278173

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  2014CN-0529844 2014-10-09

- **Fampat family**

CN104278173	A	2015-01-14	[CN104278173]

- **Abstract:**
  (CN104278173)
  The invention discloses a high-strength high-ductility TiAl alloy material and a preparation method thereof. The high-strength high-ductility TiAl alloy material comprises Ti, Al and Nb, wherein the atomic percent is (44-51)Ti-(43-47)Al-(6-9)Nb. The preparation method of the high-strength high-ductility TiAl alloy material comprises the following steps of carrying out electromagnetic induction suspension smelting on a TiAl alloy mother alloy ingot by adopting a water-cooled copper crucible, and carrying out suction casting to obtain a mother alloy rod; carrying out directional solidification on the mother alloy rod by adopting a four-mirror optical floating region directional solidification furnace, controlling the orientation of a TiAl alloy lamella, and acquiring a PST crystal; carrying out heat treatment and stress relief annealing on the PST crystal in an alpha single-phase region through a vacuum heat treatment furnace, and removing B2-phase segregation and residual stress to finally form the high-strength high-ductility TiAl alloy material. The high-strength high-ductility TiAl alloy material prepared through the method disclosed by the invention prevents the pollution of the water-cooled copper crucible on a TiAl alloy in a melting process, overcomes the defects of nonuniform component property and complicated processing of the traditional seed crystal method, is enhanced in strength and obtains outstanding room temperature tensile ductility.

Claims

(CN104278173)

1. A high strength high plastic TiAl alloy material, characterized in, in atomic percentage, the alloy composition is: (44-51) Ti-(43-47) Al-(6-9) Nb.

2. High intensity high plastic TiAl alloy material according to claim 1, characterized in, the alloy prepared by:

Electromagnetic induction(1) suspension smelting alloy button TiAl master alloy ingot, by gravity casting or suction casting alloy to give a master bar;

The(2) master alloy bar is cut on, both the lower bar, a floating zone furnace oriented as a raw material rod and seed bar optical; on, at a distance between the bar 3-5 mm; into high purity argon as a protective atmosphere, regulation, relative to the axial bar under 20-30 rpm, activating the heating, the upper, first melted at the opposite end of the bar, adjustment, at a position of the bar, the rear approaching an opposite end thereof, to adjust the power to a total power 55-70%, having a smooth surface when the floating zone melting is homogeneous, adjusting the growth rate 2.5-20 mm/h, the directional solidification;

The(3) vacuum heat treatment bar prepared TiAl alloy crystal; with 1250 °C -1350 °C x12h-cooled in the furnace 24h + 900 °C x30min/the heat treatment processes.

3. High intensity high plastic TiAl alloy material according to claim 2, characterized in, water-cooled copper crucible using electromagnetic induction step(1) suspension smelting, master alloy bar size (4-6) mmx 120 mm.

4. High intensity high plastic TiAl alloy material according to claim 2, characterized in, in high purity argon gas flow rate step(2) 3-5 L/min.

5. A high strength high plastic TiAl alloy material preparation method according to claim 1, characterized in, comprising the steps of:

Electromagnetic induction(1) suspension smelting alloy button TiAl master alloy ingot, by gravity casting or suction casting alloy to give a master bar;

The(2) master alloy bar is cut on, both the lower bar, a floating zone furnace oriented as a raw material rod and seed bar optical; on, at a distance between the bar 3-5 mm; into high purity argon as a protective atmosphere, regulation, relative to the axial bar under 20-30 rpm, activating the heating, the upper, first melted at the opposite end of the bar, adjustment, at a position of the bar, the rear approaching an opposite end thereof, to adjust the power to a total power 55-70%, having a smooth surface when the floating zone melting is homogeneous, adjusting the growth rate 2.5-20 mm/h, the directional solidification;

The(3) vacuum heat treatment bar prepared TiAl alloy crystal; with 1250 °C -1350 °C x12h-cooled in the furnace 24h + 900 °C x30min/the heat treatment processes.

6. Method for producing high strength high plastic TiAl alloy material according to claim 5, characterized in, water-cooled copper crucible using electromagnetic induction suspension smelting step(1), the master alloy bar size (4-6) mmx 120 mm.

7. High intensity high plastic TiAl alloy material production method according to claim 5, characterized in, in the step(2) of high pure argon 3-5 L/min flow rate.

Novel Beta/Gamma-TiAl alloy with ultra-fine grain
CN103409660

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- **Fampat family**

CN103409660	A	2013-11-27	[CN103409660]

- **Abstract:**
  (CN103409660)
  The invention discloses an novel beta/gamma-TiAl alloy with the ultra-fine grain. The novel Beta/Gamma-TiAl alloy comprises the following chemical components according to atomic percent: 40-45% of Al, 2-9% of Nb, 0-4% OF Cr, 0-6% of Mo, 0.1-0.3% of B, and the balance of Ti. The preparation method of the alloy comprises the following steps: electromagnetical induction and smelting in suspension by a water-cooling copper crucible, or consumable arc melting by the water-cooling copper crucible. Through the compound addition of different Beta-phase stable elements, the TiAl alloy laminated structure with the uniform structure and the uniform grain of 10 micrometers is obtained in the cast condition, and a large number of Beta-phase stable elements are stabilized to the room temperature and enriched at the grain boundary of the laminated grain.

Claims

(CN103409660)

1. One element selected from a novel / -TiAl alloy, characterized in: alloy chemical ingredients in atomic percentage: Al: 40-45%, Nb: 2-9%, Cr: 0-4%, Mo: 0-6%, B: 0.1-0.3%, the remainder being Ti, Cr alloy containing Mo in an amount cannot simultaneously represent 0 to; according to their organization: cast structure is a sheet-layer structure, the average grain size sheet to 10-30 m, phase stabilizing grains having grain boundaries to room temperature and concentrated in the manual actuation.

2. Ultra-fine grain model / -TiAl alloy according to claim 1, characterized in: the atomic percentage of Al in the alloy are: 42-43%.

3. Ultra-fine grain model / -TiAl alloy according to claim 1, characterized in: the atomic percentage of Nb in the alloy are: 4-8%.

4. Ultra-fine grain model / -TiAl alloy according to claim 1, characterized in: the atomic percentage of Cr in the alloy was: 0-2%.

5. Ultra-fine grain model / -TiAl alloy according to claim 1, characterized in: the alloy the atomic percentage of Mo was: 0-4%.

6. Ultra-fine grain model / -TiAl alloy according to claim 1, characterized in: the alloy the atomic percentage of B to a: 0.1-0.2%.

7. Ultra-fine grain model / -TiAl alloy according to claim 1, characterized in: water-cooled copper crucible for melting process is electromagnetic induction suspension smelting, comprises the following steps:

1) in accordance with a designed component ratio by weight of Al and the other half was first inserted in a water-cooled copper crucible furnace, vacuum was applied to 5x10-3Pa; high-purity argon gas to the furnace charged with an amount of pressure, the argon gas pressure in the range of 0.8-1.0 mpa, melted into an ingot, melting is performed by the other half Al;

2) melting the mother alloy ingot upon multipass, all alloy constituents together smelting 3-4 pass, to obtain a uniform mixed mother alloy ingot.

8. Ultra-fine grain model / -TiAl alloy according to claim 1, characterized in: water-cooled copper crucible for melting process is a non-consumable arc melting, comprises the following steps:

1) according to the designed component ratio of the water-cooled copper crucible furnace ingredients are placed in the inner, cover the upper oven cover evacuated to 2x10-3Pa; to the furnace charged with an amount of the high-purity argon pressure, the argon gas pressure in the range of 0.4-0.6 mpa;

2) melting the mother alloy ingot at before, will be used for suction of the ingot melting Ti 2-3-pass;

3) multipass melting the mother alloy ingot, is first consumable tungsten electrode adopted Ti, Nb, Cr, Mo and the like high melting point component melting together under the action of the electromagnetic stirring 2-3-pass, and the whole alloy melting together component 3-4 pass.

Thermal treatment process capable of reducing microsegregation of directionally-solidified high-niobium TiAl alloy

CN102400074

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- **Fampat family**

CN102400074	A	2012-04-04	[CN102400074]

- **Abstract:**
  (CN102400074)
  The invention provides a thermal treatment process capable of reducing the microsegregation of directionally-solidified high-niobium TiAl alloy. The high-niobium TiAl alloy containing trace elements such as W, B, Y, Mn and the like is prepared from the following components by atomic percent: 44-46% of Ti, 6-9% of Al, 0-2% of Nb, 0-0.5% of W and Mn, and the balance of B and Y; and a fastener ingot is obtained by virtue of electric arc melting, the fastener ingot is sucked and cast into an alloy test bar, and a directionally-solidified high-niobium TiAl alloy sample is prepared by utilizing a Bridgeman method. A directional solidification technology is utilized, so that alloy grains grow along a forced direction, the transversal grain boundary is eliminated, and the high-temperature property is improved, but as the cast high-niobium TiAl alloy has structural defects caused by ubiquitous S segregation, beta segregation and alpha segregation, the mechanical property of the alloy is finally influenced. According to the invention, heat preservation is carried out on the directionally-solidified sample at the temperature of 1250-1290 DEG C for 6-24 hours, and when the sample is cooled to 890-910 DEG C along with a furnace, heat preservation is carried out for 30-35 minutes, thus the beta segregation and the alpha segregation are greatly reduced, simultaneously recrystallization and grain growth phenomena do not appear, and the mechanical property of the alloy is effectively improved. The process provided by the invention is simple and reliable in method, low in cost and strong in practicability; and the obtained high-strength, high-toughness and directionally-solidified high-niobium TiAl alloy has a wide application prospect in the aerospace field.

Claims

(CN102400074)

1. A method for reducing high niobium titanium aluminum alloy microscopic segregation of the directional solidification heat treatment process, wherein the process is carried out in the following steps:

Step 1, using arc melting or smelting aluminum alloy ingot Niobium-Titanium high suspension smelting method button, the button causes ingot casting method using a molding process cylindrical test bars, will be placed in the test sample coated with yttria coating an alumina tube and incubated, pulling is effected by the Bridgeman method, to obtain high niobium titanium aluminum alloy sample;

Step 2, an intermediate section taken along the resulting directionally solidified high niobium titanium aluminum alloy sample;

Step 3, the test sample coated with yttria-coated alumina tube will be loaded, bubbled with argon gas, low-vacuum high-temperature treatment in an electric furnace;

Step 4, after cooling and subjected to insulation processing;

Step 5, the coupon is removed from the furnace and air cooled to room temperature, subjected to surface grinding process.

2. A method for reducing high niobium titanium aluminum alloy microscopic segregation heat treatment of the directional solidification process according to claim 1, wherein step 1 button ingots ingredient is aluminum alloy high-Titanium Ti-(44-46) Al-(6-9) Nb-(0-2) (W, Mn)-(0-0.5) (B, Y), the size of the cylindrical test bars was (4-10) xL (50-100) mm, a holding temperature of 1650oC-1700oC, pull rate of 5 m -100 m/s.

3. A method for reducing high niobium titanium aluminum alloy microscopic segregation heat treatment of the directional solidification process according to claim 1, wherein step 1 in the method for making yttrium oxide coating process: of the PEG-20000: Y2O3 to 1:3 proportioning, adding water to a paste, was poured into an alumina tube or alumina crucible, followed by baking at 110oC 30min, incubated for 30 minutes followed by furnace heating at 1200oC taken out was cooled.

4. Directional solidification of the aluminum alloy high niobium titanium for reducing microscopic segregation heat treatment process according to claim 1, wherein step 3 in the vacuum degree of 0.01-0.03Pa, after argon pressure of 600-650Pa, treatment temperature is 1250-1290oC, a heating rate of 10-12oC/min, the treatment time was 6-24h and the increase decreasing as the treatment temperature.

5. A method for reducing high niobium titanium aluminum alloy microscopic segregation of the directional solidification heat treatment process according to claim 1, wherein the step 4 is cooled at a temperature of 890-910oC, a cooling time of 30-35min.