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(54) **PLATINIUM BASED ALLOY, USE THEREOF**

PLATINBASIERTE LEGIERUNG, VERWENDUNG DAVON

ALLIAGE À BASE DE PLATINE, SON UTILISATION

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(73) Proprietor: **Richemont International S.A.**
1752 Villars-sur-Glâne (CH)

(72) Inventors:
- **LALIRE, Fanny**
  90000 BELFORT (FR)
- **POMMIER, Stéphane**
  90100 DELLE (FR)
- **DIOLOGENT, Frédéric**
  2000 NEUCHATEL (CH)
- **TROSCH, Tanja**
  92342 FREYSTADT (DE)
- **GLATZEL, Uwe**
  95445 BAYREUTH (DE)
- **VÖLKL, Rainer**
  95444 BAYREUTH (DE)

(74) Representative: **Cabinet Laurent & Charras**
Le Contemporain
50 Chemin de la Bruyère
69574 Dardilly Cedex (FR)

(56) References cited:
JP-A- H0 243 334
JP-A- S5 743 947
JP-A- S61 133 339
JP-A- S61 133 340
JP-A- S61 281 841
PL-B1- 165 298

- **J Chaston: "The Puritv of Platinum", Platinum Metals Rev., 1 April 1971 (1971-04-01), pages 122-128, XP055706098, Retrieved from the Internet: URL:https://www.technology.matthey.com/pdf/pmr-v15-i4-122-128.pdf [retrieved on 2020-06-17]**

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Description

FIELD OF THE INVENTION

[0001] The invention relates to a platinum based alloy comprising platinum and at least three different alloying elements. Due to its properties such as hardness, porosity or grain size, this alloy may be used to manufacture luxury goods.

BACKGROUND OF THE INVENTION

[0002] Due to their properties, for instance their resistance to corrosion and oxidation, precious metals have been used in jewelry for ages. However, metals such as gold or platinum are usually alloyed with one or more elements in order to improve their hardness and their ductility.

[0003] Since gold is a soft metal, it is usually alloyed with copper, silver or palladium in order to increase its hardness. The presence of additional elements can also allow the formulation of colored gold. For instance, gold may be alloyed with nickel or palladium so as to afford white gold. Gold may be alloyed with copper so as to afford rose gold.

[0004] On the other hand, platinum may be alloyed with one or more of gallium, copper, cobalt, tungsten, iridium, rhodium, ruthenium... The introduction of specific elements may improve the castability and workability of platinum, as well as the quality of the final casted parts regarding mechanical properties, color, polished state, porosities...

[0005] JPS61133339 A disclosed a Pt-(3-8)%Cr-(3-7%)Mn alloy with a hardness ranging from 210-320 Hv. Chaston: "The Puritv of Platinum", Platinum Metals Rev., 1 April 1971 disclosed elements, such as <5ppm Cu, exist as impurities in pure Pt.

[0006] Although countless platinum alloys have been developed over the last decades, there is still a need for new alloys having excellent castability and quality of the final casted items while affording hardness, porosity and grain size suitable for use in jewelry.

[0007] The present invention provides a platinum based alloy exhibiting these properties. It also affords an alternative to platinum alloys comprising gallium.

SUMMARY OF THE INVENTION

[0008] The present invention relates to a platinum based alloy that is easily castable and exhibits optimal properties and quality such as workability, hardness, porosity and grain size. Dues to its properties, this alloy is particularly appropriate for substituting the PtCuGa alloy commonly used in jewelry applications.

[0009] More specifically, the invention relates to a platinum based alloy consisting of:

- 850 wt%o or more of platinum (Pt),
- from 0.1 wt%o to 100 wt%o of a first alloying element which is at least one of manganese (Mn) and vanadium (V),
- from 0.1 wt%o to 100 wt%o of a second alloying element which is at least one of palladium (Pd) and chromium (Cr),
- wherein the platinum based alloy necessarily contains at least a third alloying element in an amount of at least 0.1 wt%o but less than 99.9 wt%o,

wherein the third alloying element is selected from the group consisting of iridium (Ir), copper (Cu), gold (Au), iron (Fe), aluminum (Al), tungsten (W), rhodium (Rh), germanium (Ge), yttrium (Y), and mixtures thereof.

[0010] It is within the skills of the skilled person in the art to adjust the amount of each element so as to reach a total of 1000 wt%o.

[0011] The platinum based alloy does not contain any gallium. The absence of gallium results in lowering the solidification interval; a narrow window may allow avoiding chemical segregating or other defects. It also results in avoiding premature hardening during brazing, welding..., which usually leads to uneven properties and flaws.

[0012] The platinum based alloy is therefore constituted of Pt; Mn and/or V; Pd and/or Cr; and at least one of Ir, Cu, Au, Fe, Al, W, Rh, Ge and Y.

[0013] The platinum based alloy may contain impurities. However, the amount of impurities is generally insignificant as it does not amount to more than 500 ppm in weight, more preferably no more than 100 ppm, and even more preferably no more than 50 ppm.

[0014] Unless otherwise stated, quantities of element(s) are expressed in weight per thousand (wt%o) or in parts per million in weight (ppm) with respect to the weight of the platinum based alloy. In other terms, 850 wt%o or more of platinum means that, for 1000 parts by weight of platinum based alloy, said alloy contains at least 850 parts by weight of platinum i.e. at least 85 wt%.

[0015] Unless otherwise stated, all numerical ranges include the end-points. For instance, the numerical range "from 0.1 wt%o to 100 wt%o" includes the 0.1 and 100 wt%o values.

[0016] Unless otherwise stated, all numerical ranges include any combination of the end-points of a range with the end-points of another range. For instance, "0.1 wt%o to 100 wt%o, preferably 0.1 wt%o to 50 wt%o, more preferably 1 wt%o to 50 wt%o, even, more preferably 1 wt%o to 25 wt%o" also includes the 0.1 wt%o to 25 wt%o range.

[0017] The alloy according to the invention has a homogeneous composition; the different elements are homogeneously spread within the alloy. It necessarily contains at least 4 elements: Pt, first alloying element, second alloying element and third alloying element. It may contain up to 14 elements: Pt; Mn and V (first alloying element); Pd and Cr (second alloying element); Ir, Cu, Au, Fe, Al, W, Rh, Ge and Y (third alloying element).

[0018] For instance, the alloy may comprise any one of the following combinations of elements:

- Pt, Mn, Pd and the third alloying element,
- Pt, Mn, Cr and the third alloying element,
- Pt, V, Pd and the third alloying element,
- Pt, V, Cr and the third alloying element.

[0019] As already mentioned, the third alloying element is at least one of Ir, Cu, Au, Fe, Al, W, Rh, Ge and Y.

[0020] As already mentioned, the platinum based alloy contains at least 850 wt%o of platinum. However, according to a preferred embodiment, it may contain between 850 wt%o and 990 wt%o of platinum.

[0021] According to another preferred embodiment, it contains 950 wt%o or more of platinum, preferably 953 wt%o or more of platinum.

[0022] Although, the platinum based alloy may contain only one of manganese or vanadium, it may comprise both of these elements. Manganese and/or vanadium are usually added to the alloy in order to improve its hardness and its mechanical properties.

[0023] As already mentioned, the platinum based alloy contains from 0.1 wt%o to 100 wt%o of manganese and/or vanadium. It preferably contains between 0.1 wt%o and 50 wt%o of at least one of manganese and vanadium, more preferably between 1 wt%o and 50 wt%o, even more preferably between 5 wt%o and 35 wt%o.

[0024] The platinum based alloy may contain only one of palladium or chromium. Nevertheless, it may comprise both of these elements. Palladium and/or chromium may be added to the alloy in order to improve its casting properties. Indeed, the melting point (or melting range) of the alloy can be adjusted by introducing more or less of Pd and/or Cr.

[0025] The platinum based alloy contains from 0.1 wt%o to 100 wt%o of palladium and/or chromium. It preferably contains between 0.1 wt%o and 50 wt%o of at least one of palladium and chromium, more preferably between 1 wt%o and 50 wt%o, even, more preferably between 1 wt%o and 25 wt%o.

[0026] In addition to Pt; Mn and/or V; Pd and/or Cr, the platinum based alloy also contains a non-zero quantity of at least one third alloying element, i.e. a non-zero quantity of any of iridium, copper, gold, iron, aluminum, tungsten, rhodium, germanium, yttrium and mixtures thereof. It contains at least 0.1 wt%o of third alloying element. It may comprise no more than 50 wt%o of third alloying element, even more preferably no more than 30 wt%o, and even more preferably no more than 25 wt%o. It can therefore comprise between 0.1 wt%o and 30 wt%o of third alloying element.

[0027] These elements can be introduced in order to improve the hardness and/or castability properties of the alloy as follows:

- Iridium: it allows increasing the hardness of the alloy. However, it degrades its castability since its presence may alter the fluidity and the form filling properties of the alloy.
- Copper: it allows narrowing the melting interval of the alloy while increasing its hardness.
- Gold: it slightly lowers the melting temperature of the alloy while increasing its hardness. However, it also increases the size grain of the alloy.
- Iron: it allows lowering the melting point of the alloy while increasing its hardness. However, its presence may alter the resistance to oxidation of the alloy.
- Aluminum: it allows lowering the melting point of the alloy. However, since it is poorly soluble within the alloy, the alloy preferably contains no more than 25 wt%o of Al.
- Tungsten: it allows increasing the hardness. It also increases the melting point
- Rhodium: it allows increasing the mechanical properties of the alloy as well as its chemical resistance.
- Germanium: it allows increasing the hardness of the alloy. However, since it is poorly soluble within the alloy, the alloy preferably contains no more than 36 wt%o of Ge.
- Yttrium: it allows lowering the melting point of the alloy while increasing its hardness and the fluidity of the melt. Due to the low solubility of Y in Pt, the alloy preferably contains no more than 1 wt%o of Y.

[0028] Since the alloy according to the invention is preferably used in jewelry, its properties such as hardness or castability have to be controlled. Based on the above, the skilled person in the art will therefore adjust the amount of Ir, Cu, Au, Fe, Al, W, Rh, Ge and Y in order to obtain the desired properties.

[0029] According to a particular embodiment, the platinum based alloy may contain any one of the following combinations of alloying elements:

- iron, copper and aluminum, preferably in combination with manganese and chromium,
- copper and gold, preferably in combination with vanadium and palladium or with manganese and palladium,
- rhodium and iridium, preferably in combination with manganese and palladium,
- iron and copper, preferably in combination with manganese and chromium,
- iron, copper and yttrium, preferably in combination with vanadium and palladium,
- iron, tungsten and germanium, preferably in combination with manganese and palladium,
- iron, copper and germanium, preferably in combination with manganese and palladium,
- iron, germanium and yttrium, preferably in combination with manganese and palladium.

[0030] The alloy contains an amount of iridium that is preferably between 0.01 and 50 wt%o, more preferably between 2 and 20 wt%o, even more preferably between 3 and 19 wt%o. The alloy contains an amount of copper that is preferably between 0.01 and 50 wt%o, more preferably between 3 and 13 wt%o.

[0031] The alloy contains an amount of gold that is preferably between 0.01 and 50 wt%o, more preferably between 4 and 22 wt%o.

[0032] The alloy contains an amount of iron that is preferably between 0.01 and 50 wt%o, more preferably between 3 and 12 wt%o.

[0033] The alloy contains an amount of aluminum that is preferably between 0.01 and 25 wt%o, more preferably between 15 and 25 wt%o.

[0034] The alloy contains an amount of tungsten that is preferably between 0.01 and 50 wt%o, more preferably between 9 and 11 wt%o.

[0035] The alloy contains an amount of rhodium that is preferably between 0.01 and 50 wt%o, more preferably between 3 and 11 wt%o.

[0036] The alloy contains an amount of germanium that is preferably between 0.01 and 36 wt%o, more preferably between 3 and 11 wt%o.

[0037] The alloy contains an amount of yttrium that is preferably between 0.01 and 1 wt%o.

[0038] The platinum based alloy is recyclable since it can be indefinitely shaped, melted and reshaped.

[0039] The platinum based alloy does not chemically interact with conventional molding apparatus. For instance, it does not react with gypsum.

[0040] According to another particular embodiment, the platinum based alloy has a Vickers hardness that preferably ranges between 80 and 350 HV, more preferably between 150 and 200HV.

[0041] According to another particular embodiment, the platinum based alloy has an elongation at break that can reach 30%.

[0042] According to another particular embodiment, the platinum based alloy has a porosity size that is preferably less than 100 μm, more preferably less than 50 μm, even more preferably less than 15 μm. The porosity size relates to the greatest dimension of a pore, for instance its diameter if a pore has the shape of a sphere.

[0043] According to another particular embodiment, the platinum based alloy has a porosity that is preferably less than 1%, more preferably less than 0.25%. The porosity relates to the total volume of pores in the alloy i.e. the volume of voids within a piece of alloy.

[0044] According to another particular embodiment, the platinum based alloy has a maximum grain size of 250 μm, preferably smaller than 150 μm. As a result of such a grain size, the items made of the platinum based alloy have a surface that does not show any flaws that are visible with the naked eye.

[0045] The above porosity and grain features may relate to the bulk form of the alloy or to a finished product resulting from the casting of the alloy.

[0046] According to another particular embodiment, the platinum based alloy has a melting temperature of less than 2000°C, preferably less than 1700°C.

The platinum based alloy is easily casted as it meets the conventional castability grid tests.

[0047] Its relatively narrow melting interval temperature, approximately 50°C, reduces, or prevents, the chemical segregation of the elements constituting the alloy.

[0048] This platinum based alloy can be prepared according to conventional techniques. The skilled person in the art will therefore be able to prepare this alloy based on the above description.

[0049] In general, the precursors of the platinum based alloy may be melted in an arc furnace or in an induction casting machine. The pure elements are first weighed, cleaned in an ultrasonic bath and then melted together, optionally under a controlled atmosphere.

[0050] Due to its properties, this platinum based alloy can be used in jewelry or in the watch industry to name a few. Indeed, the skilled person in the art will select the appropriate alloying element(s) in order to reach the desired castability

and hardness while affording proper setting properties (jewelry) and/or resistance to scratches (watch). The present invention also relates to an item comprising or consisting of the above platinum based alloy. Accordingly, this platinum based alloy can be used in order to manufacture luxury goods.

[0051] The item comprising or consisting of the above platinum based alloy can be a jewel, a leather good, or a clothing accessory. It may also be a watch, a writing accessory, or a decorative item. For instance, it can be any of the followings: ring, ear ring, necklace, bracelet, pendant, watch, buckle (belt, purse...), tie bar, cuff links, money clip, hair pin, pen, paper knife...

[0052] The invention and its advantages will become more apparent to one skilled in the art from the following examples.

EXAMPLES

[0053] Ten platinum based alloys (INV.1-10) have been prepared and compared to a conventional alloy (PtCuGa).

Table 1: Compositions (w‰)

Alloy	Pt	Mn	V	Pd	Cr	Fe	Cu	Rh	Al	Au	Ir	W	Ge	Y	Total
INV.1	953	20			3	3	5		16						1000
INV.2	953		20	20			3			4					1000
INV.3	953	6		11				11			19				1000
INV.4	953	6		12			7			22					1000
INV.5	953	31		10				3			3				1000
INV.6	953	11			11	12	13								1000
INV.7	953		18	15		10	3							1	1000
INV.8	953	6		11		10						10	10		1000
INV.9	953	6		12		11	7						11		1000
INV.10	953	30		10		3							3	1	1000

[0054] Comparative example PtCuGa is an alloy comprising 953 w%o Pt, 20 w%o Cu and 27 w%o Ga.

Table 2: Experimental results

Alloy	Hardness (HV)	Solidification temperature (°C)	Porosity (%)	Porosity size (μm)
PtCuGa	225±25	1220	0.26	16
INV.1	279±30	1400	0.49	51
INV.2	164±6	1550	0.01	51
INV.3	95±3	1800	0.05	51
INV.4	109±5	1600	0.15	39
INV.5	147±6	1800	0.04	22
INV.6	164±12	1420	0.02	9
INV.7	165±10	1420	0.01	3
INV.8	203±13	1490	0.48	27
INV.9	188±26	1410	0.14	15
INV.10	161±11	1500	0.53	11

[0055] Table 2 clearly shows that the alloy according to the invention affords similar or improved properties as compared to the conventional PtCuGa alloy.

Claims

1. Platinum based alloy consisting of:

    - 850 wt%o or more of platinum,
    - from 0.1 wt%o to 100 wt%o of a first alloying element which is at least one of manganese and vanadium,
    - from 0.1 wt%o to 100 wt%o of a second alloying element which is at least one of palladium and chromium,
    - wherein the platinum based alloy necessarily contains at least a third alloying element in an amount of at least 0.1 wt%o but less than 99.9 wt%o, wherein the third alloying element is selected from the group consisting of iridium, copper, gold, iron, aluminum, tungsten, rhodium, germanium, yttrium, and mixtures thereof.

2. Platinum based alloy according to claim 1, wherein the platinum based alloy contains between 850 wt%o and 990 wt%o of platinum.

3. Platinum based alloy according to claim 1 or 2, wherein the platinum based alloy contains 950 wt%o or more of platinum, preferably 953 wt%o or more of platinum.

4. Platinum based alloy according to any one of claims 1 to 3, wherein the platinum based alloy contains any of the following combinations:

    - platinum, manganese, palladium, and the third alloying element, or
    - platinum, manganese, chromium, and the third alloying element, or
    - platinum, vanadium, palladium, and the third alloying element, or
    - platinum, vanadium, chromium, and the third alloying element.

5. Platinum based alloy according to any one of claims 1 to 4, wherein the platinum based alloy contains between 1 wt%o and 50 wt%o of at least one of manganese and vanadium.

6. Platinum based alloy according to any one of claims 1 to 5, wherein the platinum based alloy contains between 1 wt%o and 50 wt%o of at least one of palladium and chromium.

7. Platinum based alloy according to any one of claims 1 to 6, wherein the platinum based alloy contains between 0.1 wt%o and 50 wt%o of third alloying element, preferably between 0.1 wt%o and 30 wt%o.

8. Platinum based alloy according to any one of claims 1 to 7, wherein the third alloying element is at least one element selected from the group consisting of iridium, copper, gold, iron, aluminum, tungsten, rhodium, germanium, yttrium, and mixtures thereof,
wherein
when the third alloying element is at least iridium, the platinum based alloy contains between 0.01 and 50 wt%o of iridium,
when the third alloying element is at least copper, the platinum based alloy contains between 0.01 and 50 wt%o of copper,
when the third alloying element is at least gold, the platinum based alloy contains between 0.01 and 50 wt%o of gold,
when the third alloying element is at least iron, the platinum based alloy contains between 0.01 and 50 wt%o of iron,
when the third alloying element is at least aluminum, the platinum based alloy contains between 0.01 and 25 wt%o of aluminum,
when the third alloying element is at least tungsten, the platinum based alloy contains between 0.01 and 50 wt%o of tungsten,
when the third alloying element is at least rhodium, the platinum based alloy contains between 0.01 and 50 wt%o of rhodium,
when the third alloying element is at least germanium, the platinum based alloy contains between 0.01 and 36 wt%o of germanium,
when the third alloying element is at least yttrium, the platinum based alloy contains between 0.01 and 1 wt%o of yttrium.

9. Platinum based alloy according to any one of claims 1 to 8, wherein the third alloying element is at least one element selected from the group consisting of iridium, copper, gold, iron, aluminum, tungsten, rhodium, germanium, yttrium, and mixtures thereof,

wherein
when the third alloying element is at least iridium, the platinum based alloy contains between 2 and 20 wt%o of iridium,
when the third alloying element is at least copper, the platinum based alloy contains between 3 and 13 wt%o of copper,
when the third alloying element is at least gold, the platinum based alloy contains between 4 and 22 wt%o of gold,
when the third alloying element is at least iron, the platinum based alloy contains between 3 and 12 wt%o of iron,
when the third alloying element is at least aluminum, the platinum based alloy contains between 15 and 25 wt%o of aluminum,
when the third alloying element is at least tungsten, the platinum based alloy contains between 9 and 11 wt%o of tungsten,
when the third alloying element is at least rhodium, the platinum based alloy contains between 3 and 11 wt%o of rhodium,
when the third alloying element is at least germanium, the platinum based alloy contains between 3 and 11 wt%o of germanium,
when the third alloying element is at least yttrium, the platinum based alloy contains between 0.01 and 1 wt%o of yttrium.

10. Platinum based alloy according to any one of claims 1 to 9, wherein the platinum based alloy contains any one of the following combinations of alloying elements:

- iron, copper and aluminum, preferably in combination with manganese and chromium,
- copper and gold, preferably in combination with vanadium and palladium,
- copper and gold, preferably in combination with manganese and palladium,
- rhodium and iridium, preferably in combination with manganese and palladium,
- iron and copper, preferably in combination with manganese and chromium,
- iron, copper and yttrium, preferably in combination with vanadium and palladium,
- iron, tungsten and germanium, preferably in combination with manganese and palladium,
- iron, copper and germanium, preferably in combination with manganese and palladium,
- iron, germanium and yttrium, preferably in combination with manganese and palladium.

11. Jewel comprising the platinum based alloy according to any one of claims 1 to 10.

12. Leather good comprising the platinum based alloy according to any one of claims 1 to 10.

13. Clothing accessory comprising the platinum based alloy according to any one of claims 1 to 10.

14. Use of the platinum based alloy according to any one of claims 1 to 10 in the watch industry.

15. Use of the platinum based alloy according to any one of claims 1 to 10 in the jewelry industry.

Patentansprüche

1. Platinbasierte Legierung, bestehend aus:

- 850 Gew.-%o oder mehr Platin,
- zwischen 0.1 Gew.-%o und 100 Gew.-%o eines ersten Legierungselementes, bei dem es sich mindestens entweder um Mangan oder um Vanadium handelt,
- zwischen 0.1 Gew.-%o und 100 Gew.-%o eines zweiten Legierungselementes, bei dem es sich mindestens entweder um Palladium oder Chrom handelt,
- wobei die platinbasierte Legierung notwendigerweise mindestens ein drittes Legierungselement in einer Menge von mindestens 0.1 Gew.-%o aber weniger als 99.9 Gew.-%o enthält,
- wobei das dritte Legierungselement aus der Gruppe ausgewählt wird, die aus Iridium, Kupfer, Gold, Eisen, Aluminium, Wolfram, Rhodium, Germanium, Yttrium, und Mischungen daraus besteht.

2. Platinbasierte Legierung nach Anspruch 1 oder 2, wobei die platinbasierte Legierung zwischen 850 Gew.-%o und 990 Gew.-%o Platin enthält.

3. Platinbasierte Legierung nach Anspruch 1, wobei die platinbasierte Legierung 950 Gew.-%o oder mehr Platin,

vorzugsweise 953 Gew.-‰ Platin enthält.

4. Platinbasierte Legierung nach einem der Ansprüche 1 bis 3, wobei die platinbasierte Legierung eine der folgenden Kombinationen enthält:

- Platin, Mangan, Palladium und das dritte Legierungselement, oder
- Platin, Mangan, Chrom und das dritte Legierungselement, oder
- Platin, Vanadium, Palladium und das dritte Legierungselement, oder
- Platin, Vanadium, Chrom und das dritte Legierungselement.

5. Platinbasierte Legierung nach einem der Ansprüche 1 bis 4, wobei die platinbasierte Legierung zwischen 1 Gew.-‰ und 50 Gew.-‰ an mindestens Mangan oder Vanadium enthält.

6. Platinbasierte Legierung nach einem der Ansprüche 1 bis 5, wobei die platinbasierte Legierung zwischen 1 Gew.-‰ und 50 Gew.-‰ an mindestens Palladium oder Chrom enthält.

7. Platinbasierte Legierung nach einem der Ansprüche 1 bis 6, wobei die platinbasierte Legierung zwischen 0.1 Gew.-‰ und 50 Gew.-‰ am dritten Legierungselement enthält, vorzugsweise zwischen 0.1 Gew.-‰ und 30 Gew.-‰.

8. Platinbasierte Legierung nach einem der Ansprüche 1 bis 7, wobei das dritte Legierungselement mindestens ein Element ist, das aus der Gruppe ausgewählt wird, die aus Iridium, Kupfer, Gold, Eisen, Aluminium, Wolfram, Rhodium, Germanium, Yttrium, und Mischungen daraus besteht,
wobei,
wenn das dritte Legierungselement mindestens Iridium ist, die platinbasierte Legierung zwischen 0.01 und 50 Gew.-‰ Iridium enthält,
wenn das dritte Legierungselement mindestens Kupfer ist, die platinbasierte Legierung zwischen 0.01 und 50 Gew.-‰ Kupfer enthält,
wenn das dritte Legierungselement mindestens Gold ist, die platinbasierte Legierung zwischen 0.01 und 50 Gew.-‰ Gold enthält,
wenn das dritte Legierungselement mindestens Eisen ist, die platinbasierte Legierung zwischen 0.01 und 50 Gew.-‰ Eisen enthält,
wenn das dritte Legierungselement mindestens Aluminium, ist, die platinbasierte Legierung zwischen 0.01 und 25 Gew.-‰ Aluminium enthält,
wenn das dritte Legierungselement mindestens Wolfram ist, die platinbasierte Legierung zwischen 0.01 und 50 Gew.-‰ Wolfram enthält,
wenn das dritte Legierungselement mindestens Rhodium ist, die platinbasierte Legierung zwischen 0.01 und 50 Gew.-‰ Rhodium enthält,
wenn das dritte Legierungselement mindestens Germanium ist, die platinbasierte Legierung zwischen 0.01 und 36 Gew.-‰ Germanium enthält,
wenn das dritte Legierungselement mindestens Yttrium ist, die platinbasierte Legierung zwischen 0.01 und 50 Gew.-‰ Yttrium enthält.

9. Platinbasierte Legierung nach einem der Ansprüche 1 bis 8, wobei das dritte Legierungselement mindestens ein Element ist, das aus der Gruppe ausgewählt wird, die aus Iridium, Kupfer, Gold, Eisen, Aluminium, Wolfram, Rhodium, Germanium, Yttrium, und Mischungen daraus besteht,
wobei,
wenn das dritte Legierungselement mindestens Iridium ist, die platinbasierte Legierung zwischen 2 und 20 Gew.-‰ Iridium enthält,
wenn das dritte Legierungselement mindestens Kupfer ist, die platinbasierte Legierung zwischen 2 und 13 Gew.-‰ Kupfer enthält,
wenn das dritte Legierungselement mindestens Gold ist, die platinbasierte Legierung zwischen 4 und 22 Gew.-‰ Gold enthält,
wenn das dritte Legierungselement mindestens Eisen ist, die platinbasierte Legierung zwischen 3 und 12 Gew.-‰ Eisen enthält,
wenn das dritte Legierungselement mindestens Aluminium ist, die platinbasierte Legierung zwischen 15 und 25 Gew.-‰ Aluminium enthält,
wenn das dritte Legierungselement mindestens Wolfram ist, die platinbasierte Legierung zwischen 9 und 11 Gew.-‰ Wolfram enthält,

wenn das dritte Legierungselement mindestens Rhodium ist, die platinbasierte Legierung zwischen 3 und 11 Gew.-%o Rhodium enthält,
wenn das dritte Legierungselement mindestens Germanium ist, die platinbasierte Legierung zwischen 3 und 11 Gew.-%o Germanium enthält,
wenn das dritte Legierungselement mindestens Yttrium ist, die platinbasierte Legierung zwischen 0.01 und 1 Gew.-%o Yttrium enthält.

10. Platinbasierte Legierung nach einem der Ansprüche 1 bis in 9, wobei die platinbasierte Legierung eine der folgenden Kombinationen an Legierungselementen enthält:

- Eisen, Kupfer und Aluminium, vorzugsweise in Kombination mit Mangan und Chrom,
- Kupfer und Gold, vorzugsweise in Kombination mit Vanadium und Palladium,
- Kupfer und Gold, vorzugsweise in Kombination mit Mangan und Palladium,
- Rhodium und Iridium, vorzugsweise in Kombination mit Mangan und Palladium,
- Eisen und Kupfer, vorzugsweise in Kombination mit Mangan und Chrom,
- Eisen, Kupfer und Yttrium, vorzugsweise in Kombination mit Vanadium und Palladium,
- Eisen, Wolfram und Germanium, vorzugsweise in Kombination mit Mangan und Palladium,
- Eisen, Kupfer und Germanium, vorzugsweise in Kombination mit Mangan und Palladium,
- Eisen, Germanium und Yttrium, vorzugsweise in Kombination mit Mangan und Palladium.

11. Schmuckstück mit der platinbasierten Legierung nach einem der Ansprüche 1 bis 10.

12. Lederwaren mit der platinbasierten Legierung nach einem der Ansprüche 1 bis 10.

13. Bekleidungszubehör mit der platinbasierten Legierung nach einem der Ansprüche 1 bis 10.

14. Einsatz der platinbasierten Legierung nach einem der Ansprüche 1 bis 10 in der Uhrenindustrie.

15. Einsatz der platinbasierten Legierung nach einem der Ansprüche 1 bis 10 in der Schmuckindustrie.

Revendications

1. Alliage à base de platine consistant en :

- 850 %o en poids ou plus de platine,
- de 0,1 %o à 100 %o en poids d'un premier élément d'alliage qui est au moins un parmi le manganèse et le vanadium,
- de 0,1 %o à 100 %o en poids d'un deuxième élément d'alliage qui est au moins un parmi le palladium et le chrome,
- dans lequel l'alliage à base de platine contient nécessairement au moins un troisième élément d'alliage en une quantité d'au moins 0,1 %o en poids mais inférieure à 99,9 %o en poids,

dans lequel le troisième élément d'alliage est choisi dans le groupe consistant en iridium, cuivre, or, fer, aluminium, tungstène, rhodium, germanium, yttrium, et des mélanges de ceux-ci.

2. Alliage à base de platine selon la revendication 1, dans lequel l'alliage à base de platine contient entre 850 %o et 990 %o en poids de platine.

3. Alliage à base de platine selon la revendication 1 ou 2, dans lequel l'alliage à base de platine contient 950 %o en poids ou plus de platine, de préférence 953 %o en poids ou plus de platine.

4. Alliage à base de platine selon l'une quelconque des revendications 1 à 3, dans lequel l'alliage à base de platine contient l'une quelconque des combinaisons suivantes :

- platine, manganèse, palladium et le troisième élément d'alliage, ou
- platine, manganèse, chrome et le troisième élément d'alliage, ou
- platine, vanadium, palladium et le troisième élément d'alliage, ou

- platine, vanadium, chrome et le troisième élément d'alliage.

5. Alliage à base de platine selon l'une quelconque des revendications 1 à 4, dans lequel l'alliage à base de platine contient entre 1 ‰ et 50 ‰ en poids d'au moins un parmi le manganèse et le vanadium.

6. Alliage à base de platine selon l'une quelconque des revendications 1 à 5, dans lequel l'alliage à base de platine contient entre 1 ‰ et 50 ‰ en poids d'au moins un parmi le palladium et le chrome.

7. Alliage à base de platine selon l'une quelconque des revendications 1 à 6, dans lequel l'alliage à base de platine contient entre 0,1 ‰ en poids et 50 ‰ en poids du troisième élément d'alliage, de préférence entre 0,1 ‰ en poids et 30 ‰ en poids.

8. Alliage à base de platine selon l'une quelconque des revendications 1 à 7, dans lequel le troisième élément d'alliage est au moins un élément choisi dans le groupe consistant en iridium, cuivre, or, fer, aluminium, tungstène, rhodium, germanium, yttrium et des mélanges de ceux-ci,
dans lequel
lorsque le troisième élément d'alliage est au moins de l'iridium, l'alliage à base de platine contient entre 0,01 et 50 ‰ en poids d'iridium,
lorsque le troisième élément d'alliage est au moins du cuivre, l'alliage à base de platine contient entre 0,01 et 50 ‰ en poids de cuivre,
lorsque le troisième élément d'alliage est au moins de l'or, l'alliage à base de platine contient entre 0,01 et 50 ‰ en poids d'or,
lorsque le troisième élément d'alliage est au moins du fer, l'alliage à base de platine contient entre 0,01 et 50 ‰ en poids de fer,
lorsque le troisième élément d'alliage est au moins de l'aluminium, l'alliage à base de platine contient entre 0,01 et 25 ‰ en poids d'aluminium,
lorsque le troisième élément d'alliage est au moins du tungstène, l'alliage à base de platine contient entre 0,01 et 50 ‰ en poids de tungstène,
lorsque le troisième élément d'alliage est au moins du rhodium, l'alliage à base de platine contient entre 0,01 et 50 ‰ en poids de rhodium,
lorsque le troisième élément d'alliage est au moins du germanium, l'alliage à base de platine contient entre 0,01 et 36 ‰ en poids de germanium,
lorsque le troisième élément d'alliage est au moins de l'yttrium, l'alliage à base de platine contient entre 0,01 et 1 ‰ en poids d'yttrium.

9. Alliage à base de platine selon l'une quelconque des revendications 1 à 8, dans lequel le troisième élément d'alliage est au moins un élément choisi dans le groupe consistant en iridium, cuivre, or, fer, aluminium, tungstène, rhodium, germanium, yttrium et des mélanges de ceux-ci,
dans lequel
lorsque le troisième élément d'alliage est au moins de l'iridium, l'alliage à base de platine contient entre 2 et 20 ‰ en poids d'iridium,
lorsque le troisième élément d'alliage est au moins du cuivre, l'alliage à base de platine contient entre 3 et 13 ‰ en poids de cuivre,
lorsque le troisième élément d'alliage est au moins de l'or, l'alliage à base de platine contient entre 4 et 22 ‰ en poids d'or,
lorsque le troisième élément d'alliage est au moins du fer, l'alliage à base de platine contient entre 3 et 12 ‰ en poids de fer,
lorsque le troisième élément d'alliage est au moins de l'aluminium, l'alliage à base de platine contient entre 15 et 25 ‰ en poids d'aluminium,
lorsque le troisième élément d'alliage est au moins du tungstène, l'alliage à base de platine contient entre 9 et 11 ‰ en poids de tungstène,
lorsque le troisième élément d'alliage est au moins du rhodium, l'alliage à base de platine contient entre 3 et 11 ‰ en poids de rhodium,
lorsque le troisième élément d'alliage est au moins du germanium, l'alliage à base de platine contient entre 3 et 11 ‰ en poids de germanium,
lorsque le troisième élément d'alliage est au moins de l'yttrium, l'alliage à base de platine contient entre 0,01 et 1 ‰ en poids d'yttrium.

10. Alliage à base de platine selon l'une quelconque des revendications 1 à 9, dans lequel l'alliage à base de platine contient l'une quelconque des combinaisons suivantes d'éléments d'alliage :

- fer, cuivre et aluminium, de préférence en combinaison avec manganèse et chrome,
- cuivre et or, de préférence en combinaison avec vanadium et palladium,
- cuivre et or, de préférence en combinaison avec manganèse et palladium,
- rhodium et iridium, de préférence en combinaison avec manganèse et palladium,
- fer et cuivre, de préférence en combinaison avec manganèse et chrome,
- fer, cuivre et yttrium, de préférence en combinaison avec vanadium et palladium,
- fer, tungstène et germanium, de préférence en combinaison avec manganèse et palladium,
- fer, cuivre et germanium, de préférence en combinaison avec le manganèse et palladium,
- fer, germanium et yttrium, de préférence en combinaison avec manganèse et palladium.

11. Bijou comprenant l'alliage à base de platine selon l'une quelconque des revendications 1 à 10.

12. Produit de maroquinerie comprenant l'alliage à base de platine selon l'une quelconque des revendications 1 à 10.

13. Accessoire de vêtement comprenant l'alliage à base de platine selon l'une quelconque des revendications 1 à 10.

14. Utilisation de l'alliage à base de platine selon l'une quelconque des revendications 1 à 10 dans l'industrie horlogère.

15. Utilisation de l'alliage à base de platine selon l'une quelconque des revendications 1 à 10 dans l'industrie de la bijouterie.

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP S61133339 B **[0005]**

Non-patent literature cited in the description

- **HV. CHASTON.** The Puritv of Platinum. *Platinum Metals Rev.,* 01 April 1971 **[0005]**