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⑤④ A gold alloy.

⑤⑦ An alloy consisting of gold and 0.1 to 4% by weight of titanium.

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PATENTANWÄLTE

0190648

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A Gold Alloy

EDUARD-SCHMID-STRASSE 2
8000 MUNCHEN 90

Priority:

TELEFON (089) 652091
TELEX 523467 (wilp-d)

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THIS INVENTION relates to a gold alloy. The alloy may particularly be used for the production of jewellery, coins or gold bars.

The quality of fine gold jewellery, coins and small bars is adversely affected by the metal's malleability and low hardness which make its wear resistance very low. When gold is used for jewellery it is thus usually alloyed with metals such as copper, silver, zinc, nickel and palladium. The resultant improvement in mechanical and wear properties is accompanied by poorer chemical properties which lead to corrosion and tarnishing and increase the risk of stress corrosion cracking in alloys with less than 583 millesimal fineness (14 carat). The use of alloys has the advantage, however, of allowing various colours to be produced by incorporating different alloying metals.

The intrinsic value of jewellery is sometimes an important factor and in Hong Kong, for example, so-called '24-carat' jewellery is very popular and this must have a millesimal fineness of at least 990. There
5 is thus a need for an alloy which has such purity and possesses an acceptable colour and good chemical and mechanical properties and is also amenable to the usual goldsmith's procedures such as soldering, bending, casting, rolling and drawing.

10 According to the invention there is provided a gold alloy, containing gold and 0.1 to 4.0 % mass by mass (m/m) of titanium. As indicated above, the alloy may particularly be used for the production of jewellery, coins or gold bars. By incorporation of
15 titanium within the concentration limits claimed, an alloy can be obtained which is harder and therefore more resistant to abrasion, and which is at the same time of a high degree of fineness, and of a desirable bright colour.

20 The invention extends to a method of manufacturing a gold alloy which includes
melting a suitable amount of gold; and
dissolving therein a suitable amount of titanium such that the titanium comprises 0.1 to 4.0 % m/m.

The Applicant has found after extensive experimentation that titanium is very suitable to alloy with gold. It has solubilities of about 2.2 % m/m at 1000°C, 1.2% at 800°C and 0.5% at 500°C. The hardening phase formed in the solid state is Au₄Ti. Furthermore, one % m/m of titanium in gold represents more than 4 atomic % due to the atomic weights of 48 and 197 which the two metals possess respectively. Fortunately, the titanium also gives the gold an attractive lighter yellow colour.

The alloy preferably has 0.5 to 1.5 % m/m titanium and most preferably has 1 % m/m titanium.

Titanium fulfils the following requirements that an effective hardening agent for gold with a millesimal finess of 990 should have:

- a) be soluble in molten gold at more than the 1% level;
- b) be soluble at the 1% level in solid gold at a reasonable solutionising temperature (say 800°C);
- c) form a crystallographic hardening phase at a temperature of about 500°C, which has many gold atoms per atom of additive and is thus a highly effective hardening agent; and
- d) have an atomic weight that is much lower

than that of gold so that 1% m/m represents a greater atomic %.

Experimental work has been carried out which shows that a 990 fineness Au/Ti alloy possesses many of the properties required for applications in jewellery manufacture.

An example of an alloy in accordance with the invention, and its method of manufacture is as follows:-

99 grams of gold that was 99.99% pure, was melted with 1 gram of titanium that was 99.7% pure in the form of a rod. Titanium metal reacts with both oxygen and nitrogen on heating, and is normally covered with a very thin skin of oxide and/or nitride. This skin acts as a barrier and impedes solution of the titanium in the gold during alloy production. Thus the titanium should be in bulk form with minimal surface area.

The gold and titanium were heated and melted in a ceramic crucible to a temperature of about 1300°C in a medium vacuum which must not be better than 10^{-2} Torr or evaporation of the molten gold will occur. Instead of a vacuum, a high quality (99.998% pure) argon protective atmosphere may be used. The

melting took place in an induction furnace using a carbon crucible with an inner ceramic lining.

The melt was cast into a carbon mould at 400°C, again in a medium vacuum.

5 The resulting ingot was then held at a temperature of about 800°C for 30 to 60 minutes for solutionising to take place. This was also done in a vacuum.

10 The soft alloy obtained after solutionising was then hardened by being held at a temperature of about 500°C for about 60 minutes. After hardening in this manner the ingot had a hardness of 180 HV 0.5.

15 The hardness of the ingot could be further increased by up to 300 HV 0.5 by cold-working. Reduction to quarter of the original thickness by rolling is tolerated between solutionising treatments.

CLAIMS

1. A gold alloy containing from 0.1 to 4 % m/m titanium, the balance being gold.
2. The alloy claimed in Claim 1 in which the titanium is 0.5 to 1.5 % m/m.
3. The alloy claimed in Claim 1 containing 1 % m/m titanium, the balance being gold.
4. An item of jewellery which is of an alloy as claimed in any one of the preceding claims.
5. A coin which is of an alloy as claimed in any one of Claims 1 to 3.
6. A gold bar which is of an alloy as claimed in any one of Claims 1 to 3.
7. A method of manufacturing a gold alloy which includes
melting a suitable amount of gold; and
dissolving therein a suitable amount of titanium
such that the titanium comprises 0.1 to 4.0 % m/m.

8. The method claimed in Claim 7, in which the titanium is dissolved in the gold in a vacuum.

9. The method claimed in Claim 7, in which the titanium is dissolved in the gold under an inert atmosphere.

10. The method claimed in Claim 7, in which the titanium is added to the gold in bulk form.

11. The method claimed in Claim 7, in which the molten gold and titanium dissolved therein is cooled to a temperature of about 800°C and held at this temperature for about 30 to 60 minutes.

12. The method claimed in Claim 7, which includes age hardening at a temperature of about 500°C for a period of about 60 minutes.



DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. 4)
X	CHEMICAL ABSTRACTS, vol. 81, no. 8, 26th August 1974, page 205, no. 40552k, Columbus, Ohio, US; M. GRAHAM: "Precipitation hardening in gold-titanium alloys", & PROC. ELECTRON MICROSC. SOC. AMER. 1973, 31, 148-9 * Abstract *	1	C 22 C 5/02 A 44 C 27/00 A 44 C 21/00 C 22 C 1/02
X	--- Dr.phil. M. HANSEN: "Constitution of binary alloys", 2nd edition, 1958, pages 237-239, McGraw-Hill Book Co., Inc., New York, US * Pages 237-239 *	1,2,7,9	
X	Idem * Supplement 1, Elliott, pages 105-106 *	1,2	TECHNICAL FIELDS SEARCHED (Int. Cl. 4)
X	Idem * Supplement 2, Shunk, pages 79-80 *	1,2	C 22 C 5/02
A	--- GB-A- 876 887 (DEUTSCHE GOLD-UND SILBER SCHEIDE ANSTALT VORMALS ROESSELR) * Claim 1 * & DE - B - 1 121 339 --- -/-	1	
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 24-04-1986	Examiner LIPPENS M.H.
<p>CATEGORY OF CITED DOCUMENTS</p> <p>X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document</p> <p>T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document</p>			



DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
A	DE-A-2 302 837 (Dr. WIELAND SCHEIDEANSTALT) * Claims 1,2 * -----	1	
			TECHNICAL FIELDS SEARCHED (Int. Cl.4)
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 24-04-1986	Examiner LIPPENS M.H.
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