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(54) Electroplated blank for coins, medallions and tokens.

(57) An electroplated blank is disclosed capable of having insignia minted on at least one face to form coins, medallions or tokens, the blank comprising a metallic core e.g. of steel, with an electroplated coating comprising 0.5 to 8% by weight tin, the balance copper, completely enveloping said blank and having a thickness of from about 5 μm to about 50 μm.

EP 0 450 883 A2

This invention relates to metal alloy coins, medallions or tokens and to blanks used for the production of coins, medallions or tokens. More particularly, this invention relates to said coins, blanks and medallions and to blanks for the production thereof having improved wear resistance compared to copper coins while maintaining a cupric lustre and appearance.

In recent years, the rising cost of coinage metals has encouraged many countries to strike relatively inexpensive alloy coins in an effort to obtain reduced production costs. Various alloys of copper and zinc as well as of nickel, aluminium and other metals have been used with varying success.

The integrity of the coins are frequently judged by the general public by their appearance which is expected to be of a lustre of gold, silver or copper, depending on their face value. It is important that the coins do not change colour with age or otherwise corrode. In addition to avoiding these undesirable features, any new electrical and magnetic properties to permit them to be acceptance for use in vending machines.

Other requirement for new alloyed coins are that they must not be easy to counterfeit, should provide specific properties for coin selection devices, must be capable of taking a good mint impression while having a sufficient surface hardness to avoid undue wear, and should be inexpensive.

In EP 0163419B there are disclosed aureate coin and coin blanks having an electroplated coating on a metal core, the coating containing about 8 to 16%, preferably about 11 to 14%, by weight tin, the balance copper. The coating thickness on the core faces is about 10 to 15 µm, preferably about 30 to 50 µm. The coins and blanks have a golden appearance and are suitable for replacement of gold coins.

Because of the high cost of the refined copper, pure copper or copper alloy coins currently in use are expensive and the seigneurage, which is the difference between the face value of the coin and its production cost, becomes small or of deficit value. Attempts to produce pure copper plating on low value cores in the past were found to produce coins subject to corrosion and wear problems. This was believed to be due to the coarse grain size, deposit porosity and the inherent poor wear resistance of such copper.

In accordance with the present invention, coin and coin blanks are provided comprising a low tin bronze alloy bonded to a metallic core, the bronze alloy having a fine grain structure which provides good corrosion and wear resistance. The tin-copper (bronze) alloy used is believed to provide better protection to the core than pure copper due to a weaker galvanic corrosion couple between the metals and due to a more dense electrodeposit.

More particularly the present invention provides an electroplated coin blank capable of having an insignia minted on at least one face, comprising: a core blank of a first metallic material, preferably steel, said core blank having at least one face impressionable by a mint die, and an electroplated coating of a second metallic material encasing said core blank and providing a surface thickness on at least said impressionable face of from about 5 µm to about 50 µm, said second metallic material having a tin content of at least about 0.5% but less than 8.0% by weight, preferably in the range 2% up to but not including 8%, and most preferably about 2.0% with the balance being copper and incidental impurities.

Also included within the scope of the invention, of course, are coins produced by minting the blanks to provide an impression on said impressionable face, or, as will usually be the case, on both faces.

Also it is to be understood that although the preceding description and the following examples make reference to coin blanks, it will be understood that the term "coin" used herein in the specification and claims is intended to include coins, medallions and tokens and blanks therefor. Also, although the metallic material of the core blank is exemplified in the following examples as low carbon steel, it will be understood that the metallic core material may for example comprise iron, low carbon steel, stainless steel, nickel, nickel-plated steel, zinc, or alloys of zinc, copper or various alloys of copper containing zinc and/or nickel and/or tin, and aluminium or aluminium alloys suitable pretreated.

The core may be advantageously annealed before or after plating, to give the blank with electroplated coating a satisfactory low hardness for minting. Annealing after electroplating is also advantageous in that it can be used to create a metallurgical bond by interdiffusion between the electroplated low tin copper coating and the core material. For this purpose the electroplated blank is preferably annealed prior to minting by heating in a reducing atmosphere, e.g. in an atmosphere of hydrogen gas for up to 15 minutes at about 700°C.

If the core material is already soft enough for minting, as with a zinc core, the annealing before plating can be omitted. Also the core may be burnished before or after annealing, in order to give the electroplated block a satisfactory lustre.

The method of the intention and the products produced thereby will now be described with reference to the following examples and the accompanying drawings, in which:

Figure 1 is a cross-section showing the microstructure of annealed copper bonded steel (C-B-S) and of bronze bonded steel coinage blanks (B-B-S) produced according to the method if the invention; and

Figure 2 is a graph showing thickness loss as a result of wear over time.

EXAMPLE 1

A bath of tinned coinage blanks made of low carbon steel and weighing 949 grams was loaded into a perforated, rotatable, horizontal plating barrel having a length of 15 cm and a diameter of 10 cm. The barrel was first passed through a cleaning cycle consisting of sequential washes in a 10% detergent solution, cold water, 10% hydrochloric acid, and a second cold water wash. The blanks were then immersed in an alkaline cyanide bronze plating bath containing copper, tin, potassium hydroxide and potassium cyanide. A current of 15 amps was applied to the bath for approximately 1.8 hours while the temperature of the bath was maintained between about 55°C and 60°C.

When removed from the bath, the total mass of coinage blanks was found to have increased by 58.7 gram equivalents, equivalent to 5.82% of the total charge weight of the blanks. A wet analysis of the blanks showed them to have a deposit of 2.12% tin by weight.

After plating, the coinage blanks were annealed in a reducing atmosphere at 700°C for 15 minutes in the presence of hydrogen. The coinage blanks were found to have an electrodeposit thickness of bronze on their faces of approximately 0.021 μm, and around their rims of approximately 0.030 μm.

Such coatings were found to be metallurgically bonded to the steel blanks and had a finer grain deposit and provided improved corrosion and wear resistance compared to pure copper similarly bonded.

EXAMPLE 2

Bronze bonded steel (B-B-S) coinage blanks prepared according to the process of the present invention were evaluated with copper bonded steel (C-B-S) blanks and Canadian one cent coin blanks for corrosion resistance and wear resistance. The coin blanks were immersed in a 2% NaCl bath for the corrosion test and tumbled in a rotating drum for the wear test.

The parameters of the coinage test samples are shown in Table 1.

Table 1

Sample	Diameter (mm)	Thickness (mm)	Weight (g)	Deposit		
				Thk μm	Wt %	Comp'n %
C-B-S	18.56	0.98	2.22	Face:21 Edge:30	5.78	100 Cu
B-B-S	18.57	0.98	2.22	Face:21 Edge:31	5.83	2.1 Sn 97.9 Cu
Cdn. 1¢	19.05	1.38	2.50	N/A	N/A	1.5 Zn 0.5 Sn 98.0 Cu

In the corrosion test, coins or blanks were immersed in a 2% NaCl solution for 4 hours. The results of a corrosion test conducted on 10 samples of each blank type are shown in Table 2.

Sample	On Faces	On Edge
C-B-S	11 rust spots/ 10 blanks	7 rust spots/ 10 blanks
B-B-S	0/10 blanks	0/10 blanks
Canadian 1¢	0/10 blanks	o/10 blanks

Black rust spots were found only on the copper bonded steel samples. All rust spots were smaller than 1 mm in size.

EXAMPLE 3

A rotating drum wear test was carried out on 16 samples of each blank type. In this test, samples were tumbled in a rotating cylinder having a cloth lining backed by rubber, a hump on the circumference to tumble the pieces each revolution, and a loading hole on one side. At the start, pieces were weighed, dipped in synthetic sweat solution, sealed into the cylinder and rotated, with the test cycle being repeated at 100 hour intervals. The cumulative average surface thickness loss for the samples as a function of test duration up to 300 hours is shown in Figure 2. The bronze bonded steel samples showed better wear resistance than the copper bonded steel blanks and Canadian one cent samples, while the latter two sample types had similar wear resistance over the 300 hour test period.

In general, the bronze bonded steel blanks were superior to the copper bonded steel blanks in both corrosion and wear tests.

The steel core blanks were sufficiently soft to take a clear impression from a mint die without causing undue wear on such dies. The electrodeposited alloy coating exhibited sufficient surface hardness that the insignia minted thereon was not worn away after prolonged wear testing.

While this invention is particularly suitable for producing coins to be used as legal tender, it will be understood that it is beneficial in the production of medallions, tokens and metallic tags as well. Other embodiments of the invention will be readily apparent to a person skilled in the art without departing from the scope of the invention herein described.

Claims

1. A coin, coin blank, medallion, medallion blank, token or token blank comprising a core of mintable metallic material having at least one surface bearing, or capable of bearing a minted impression, and an electroplated coating of a copper-tin alloy completely encasing the core, said coating having a thickness, at least on said core surface, in the range of 5 μm to 50 μm, characterised in that the electroplated coating comprises a copper-tin alloy containing at least 0.5% by weight but less than 8.0% tin and the balance copper.

2. A coin, medallion, token or blank as claimed in claim 1, wherein the mintable metallic core is composed of iron, low carbon steel, stainless steel, nickel, nickel-plated steel, zinc or zinc alloy, copper or copper alloy, magnesium or magnesium alloy, or pretreated aluminium or aluminium alloy.

3. A coin, medallion, token or blank as claimed in claim 1 or 2, wherein the electroplated coating is a copper-tin alloy containing about 2% by weight tin and the balance copper.

4. A coin, medallion, token or blank as claimed in any one of claims 1 to 3 wherein the electroplated coating is metallurgically bonded to the core by interdiffusion due to heat treatment of the electroplated core after electroplating but before minting.

5. A coin, medallion, token or blank as claimed in claim 4, in which the core is low carbon steel and the electroplated coating is a coppertin alloy containing about 2% by weight tin and the balance copper.

6. A method of producing an electroplated blank for a coin, medallion or token which comprises forming a metal core from a mintable first metal, said core having at least one surface which is to be provided with a minted impression, and electroplating the core, prior to minting, with a copper-tin alloy to provide, at least on said one surface, an electroplated copper-tin alloy coating having a thickness of from 5 to 50 μm, characterised in that the copper-tin alloy deposited on the core by electrodeposition comprises at least 0.5% but less than 8.0% by weight tin and the balance copper.

7. A method according to claim 6, in which the core blank is subjected to a dilute acid rinse prior to electroplating.

8. A method according to claims 6 or 7, in which the core blank is annealed prior to electroplating.

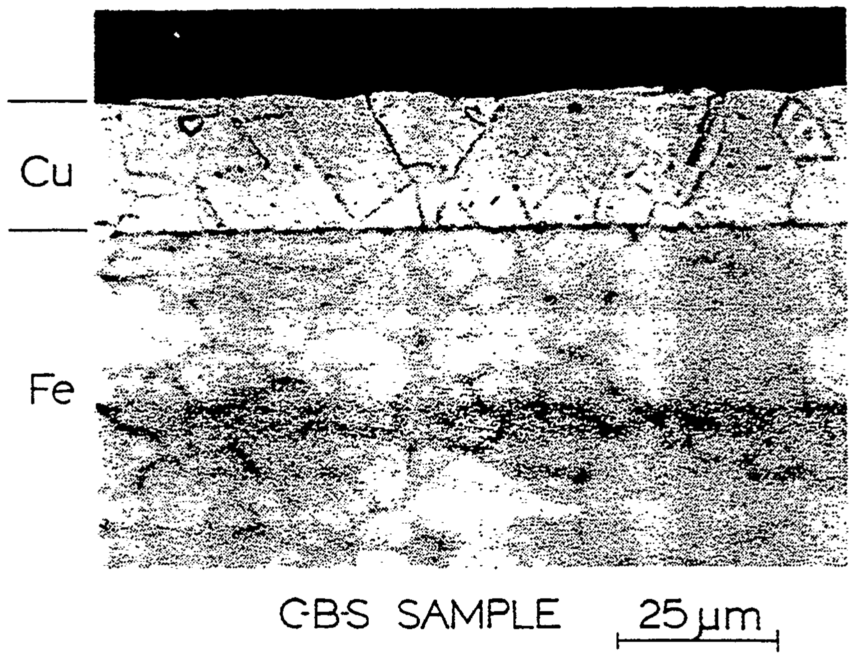
9. A method according to claims 6, 7 or 8, in which the core blank is annealed after electroplating and prior to minting to provide a metallurgical bond between the electrodeposited coating and the core material.

10. A method according to claim 9 wherein the electroplated core is annealed prior to minting by heating the electroplated core in a reducing atmosphere for up to 15 minutes at about 700°C in the presence of a reducing gas.

11. A method according to claim 10, wherein said reducing gas is hydrogen.

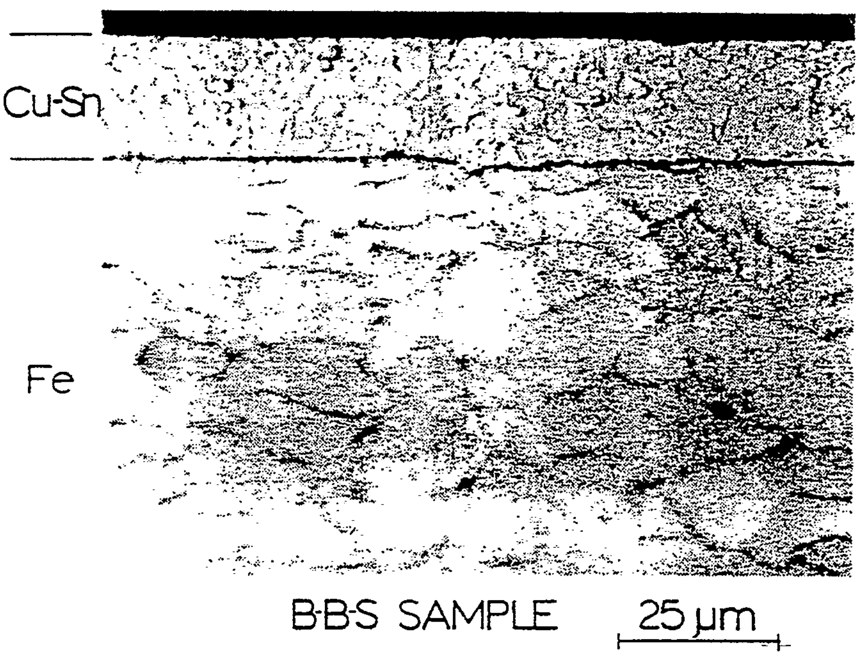
12. A method according to any one of claims 6 to 11, including the further step of minting the electroplated blank to provide a coin, medallion token having a minted impression on said at least one surface.

FIG. 1A



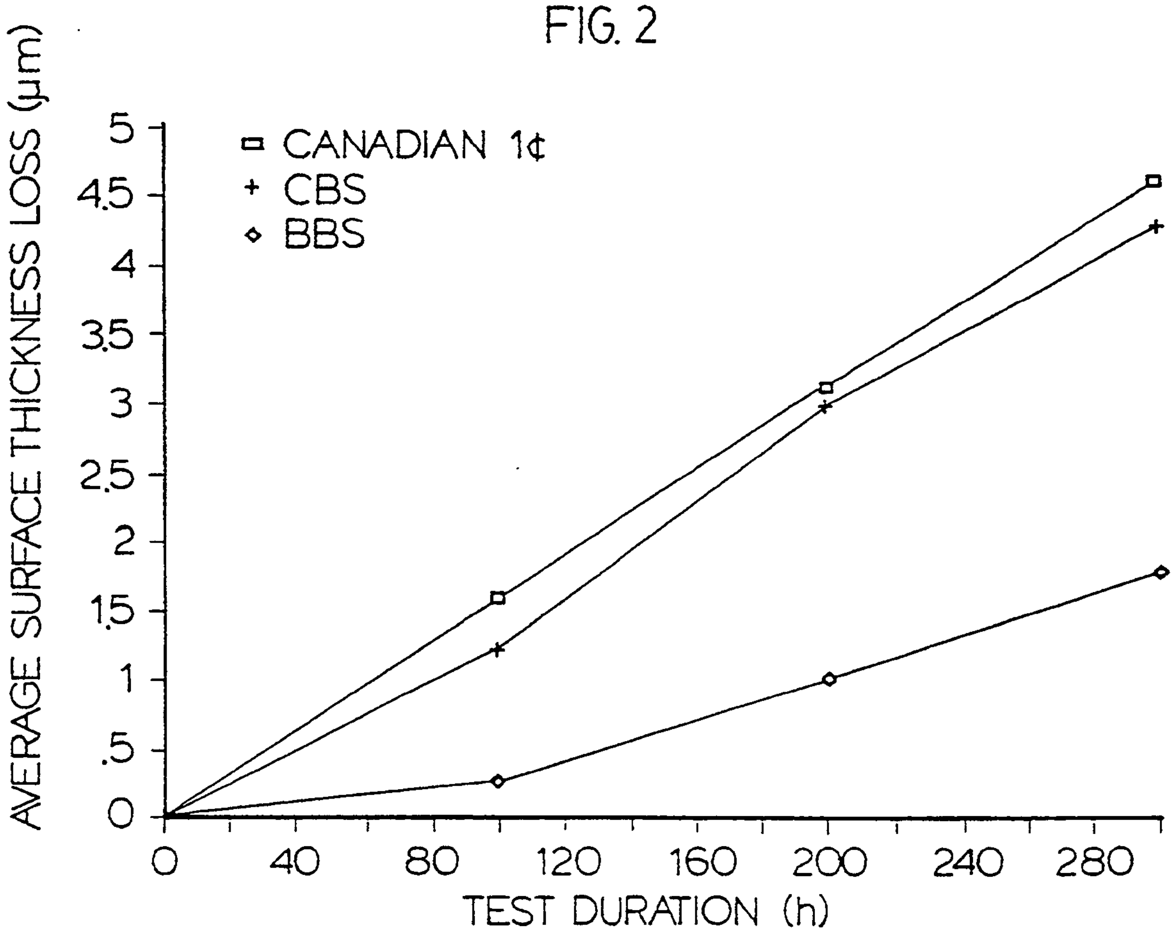
C-B-S SAMPLE

FIG. 1B



B-B-S SAMPLE

FIG. 2


AVERAGE SURFACE THICKNESS LOSS (µm)
5
4.5
4
3.5
3
2.5
2
1.5
1
.5
0
CANADIAN 1¢
CBS
BBS
0
40
80
120
160
200
240
280
TEST DURATION (h)