



### **Composite, Stratified Material and its Use for Coins**

The invention relates to a stratified composite material consisting of a core-layer, plated on each side with a layer of steel; and its use for coins, chips, and tokens, and suchlike.

5 When, in earlier times, it was important for the value of the metal in coins to be equal to their face value, this requirement determined the choice of metal. Gold, silver, and non-precious metals, and alloys thereof, were used. In the course of industrialization from the mid 19th century onward, more and more coins of low intrinsic value came into circulation, the material of which was chosen for low cost of manufacture on the  
10 one hand, and for visual appearance on the other.

Often nickel and certain copper alloys were used. Latterly, there has been more and more call for cheaper coins. In the course of this development, various types of rustproof steel have also already been made into coins — mainly ferritic steel X 6 Cr 17 (German Material No. 1.4016) and austenitic steel X 5 CrNi 18 12 (German Material No. 1.4303).

15 More widespread use of high-grade steel as a coinage material has hitherto been prevented by the problems of imprinting it. Due to hardness numbers that in practice are still about 140 to 160 Hv30, or on average about 150 Hv30 in the soft-annealed state, the imprinted images are relatively shallow, although they are very resistant to abrasion and the coins remain corrosion-resistant for a long time, as described e.g. in "Coinage  
20 Materials, XVII Mint Directors' Conference Madrid 1992".

Also the bluish colour, particularly of ferritic rustproof steels, makes them look less valuable than the whiter-looking coinage materials such as silver or nickel and alloys thereof.

In contrast to the mechanical coin-testers normally used in the past, the electronic  
25 coin-testers widely used nowadays will not only measure a coin's diameter and thickness but will also measure its electric conductivity inductively at various frequencies, i.e. at various distances from its outer surface. This enables stratified composites to be recognized with particular certainty, and to be separated from foreign coins and counterfeits.

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As a result, a further important criterion in the production of coinage materials is that the properties of the material — such as density, electric conductivity, and magnetization behaviour — must be adjusted to within a very narrow acceptance range.

- 5 JP 4 66 651 and US 27 75 520 disclose stainless chromium-nickel steel alloys containing on average 17.8 mass-% chromium, 12.8 mass-% nickel, and 3 mass-% copper, for use as coinage materials for single-layer coins. The objective of the invention is to now provide a rustproof material which is easier to imprint than state-of-the-art materials, and at the same time looks white or silvery, and which can, in  
10 addition, be made into coins that can be distinguished with certainty from other coins or counterfeit coins in today's automatic coin-testers.

This objective is achieved, according to the invention, with a stratified composite material that has a core-layer of a ferritic chromium steel plated on both sides with a layer of steel having the following composition (mass-percent):

|    |          |      |    |      |
|----|----------|------|----|------|
| 15 | chromium | 16.0 | to | 18.0 |
|    | nickel   | 10.0 | to | 12.0 |
|    | copper   | 3.5  | to | 4.5  |

with the remainder being iron and manufacturing-impurities.

- Optionally, one or more of the following elements can be added to steel used for said  
20 plating (amounts expressed as mass-%):

|    |            |       |      |
|----|------------|-------|------|
|    | manganese  | 1.5   | max. |
|    | silicon    | 0.4   | max. |
|    | carbon     | 0.02  | max. |
|    | nitrogen   | 0.02  | max. |
| 25 | sulfur     | 0.01  | max. |
|    | phosphorus | 0.03  | max. |
|    | molybdenum | 1.0   | max. |
|    | titanium   | 0.03  | max. |
|    | niobium    | 0.05  | max. |
| 30 | aluminium  | 0.1   | max. |
|    | cobalt     | 0.3   | max. |
|    | boron      | 0.003 | max. |

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It is advantageous if the thickness of the plated-on layers is 10 to 30% of the overall thickness of the stratified composite material.

Surprisingly, it has been found that a stratified composite material consisting of such a steel in the soft-annealed state not only has the desired white or silvery look, but also is  
5 able to have its hardness kept distinctly below 140 Hv30, and indeed generally even below 120 Hv30.

These hardness numbers, which are on average about 20% lower than those for the rustproof steel used for coin blanks in the state of the art, make it possible to achieve a very much deeper and very much more three-dimensional imprinted image. Despite  
10 this, the resistance to abrasion of this new coinage material, as determined in a drum-test on test coins, is comparable to that of the high-grade steels X 6 Cr 17 and X 5 CrNi 18 12, and is higher, by a factor of approximately 3, than that of conventional copper-based coinage materials such as CuAl<sub>6</sub>Ni<sub>2</sub>.

The new coinage material's comparability to other high-grade steels was also shown in  
15 testing for resistance to tarnishing in an aggressive laboratory atmosphere, over a 10% NaCl solution and with subjection to artificial sweat.

If such a stratified composite material has, according to the invention, a core-layer of ferritic chromium-steel coated on each side with a steel according to the invention, this will ensure that the resultant coins can be distinguished from other coins or counterfeits  
20 in coin-testers commonly used today.

The invention will now be described in greater detail, using an example of its embodiment:

A copper-alloyed stainless steel with the following composition (in mass-%) was melted:

|    |           |       |
|----|-----------|-------|
|    | chromium  | 17.35 |
| 25 | nickel    | 10.25 |
|    | copper    | 3.65  |
|    | manganese | 0.67  |
|    | silicon   | 0.30  |
|    | carbon    | 0.014 |
| 30 | nitrogen  | 0.015 |
|    | sulfur    | 0.003 |

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|             |         |
|-------------|---------|
| phosphorus  | 0.012   |
| molybdenum  | 0.49    |
| titanium    | < 0.010 |
| niobium     | 0.010   |
| 5 aluminium | 0.020   |
| cobalt      | 0.01    |
| boron       | 0.002   |

the remainder being iron and manufacturing-impurities.

10 The steel was hot- and then cold-rolled to produce a strip 2.07 mm thick. Coin blanks with a diameter of 25.30 mm were then punched out of the cold rolled strip. These blanks were of the desired silvery-white colour.

After reeding, the diameter was 24.85 mm. Each disk weighed 8.10 g, and had a density of 7.98/cm<sup>3</sup>. The disks were able to be adjusted to a hardness of 117 Hv30 without coarse-grain formation: consequently they were easy to imprint, as was  
15 determined by striking test-coins.

In a 24-hour drum test, these coins were compared with others made of the stainless steels X 6 Cr 17 and X 5 CrNi 18 12, commonly used for coining; and the loss of mass with all three materials was 0.1%. Coins made of the very commonly used copper material CuAl<sub>6</sub>Ni<sub>2</sub>, on the other hand, wore three times as much.

20 In a corrosion test, too, in an aggressive laboratory atmosphere, over a 10% NaCl solution and with subjection to artificial sweat, the new coinage material had only insignificantly altered after three weeks.

Strips of this embodiment-example were plated onto both sides of ferritic chromium steel X 6 Cr 17. The thickness of each such outer layer was 20% of the overall thickness,  
25 with the consequence that the resultant coins can be distinguished with certainty from other coins and counterfeits in coin-testers commonly used today.

A further, excellent feature of the invention that should be mentioned is that the proposed new coinage material can be recycled with no trouble, by means of steel-work technologies commonly used today; and this is true not only when it is used as a sole  
30 component but also when it is used as a component of a composite material together with a ferritic chromium steel.

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**What We Claim is:—**

1. A stratified composite material for coins, chips, tokens, and suchlike, **characterized in that** said composite has a core-layer of ferritic chromium steel, plated on each side with a layer of steel consisting of (by mass-%):

|          |      |    |      |
|----------|------|----|------|
| chromium | 16.0 | to | 18.0 |
| nickel   | 10.0 | to | 12.0 |
| copper   | 3.5  | to | 4.5  |

with the remainder being iron and manufacturing-impurities.

2. A stratified composite material as claimed in claim 1, **characterized in that** the steel used for plating the core-layer contains, in addition, one or more of the following elements (by mass-%):

|            |       |      |
|------------|-------|------|
| manganese  | 1.5   | max. |
| silicon    | 0.4   | max. |
| carbon     | 0.02  | max. |
| nitrogen   | 0.02  | max. |
| sulfur     | 0.01  | max. |
| phosphorus | 0.03  | max. |
| molybdenum | 1.0   | max. |
| titanium   | 0.03  | max. |
| niobium    | 0.05  | max. |
| aluminium  | 0.1   | max. |
| cobalt     | 0.3   | max. |
| boron      | 0.003 | max. |

3. A stratified composite material as claimed in claim 1 or 2, **characterized in that** the thickness of the plated-on layers is 10 to 30% of the overall thickness of the stratified composite material.
4. A stratified composite material as claimed in claim 1, 2, or 3, **characterized in that** the core-layer consists of the material X 6 Cr 17.
5. Use of a stratified composite material as claimed in claim 1, 2, 3, or 4 as a material for the production of imprinted coins, chips, tokens, or suchlike.

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