

PVD coating mask

The invention relates to a mask, in particular for use in selective PVD coating with noble metal coatings according to claim 1 or claim 11, and to the use of such a mask according to claim 10.

In the coating of substrates, for example by means of a sputtering, vacuum sputtering or PVD method, it is frequently required to coat only part of the substrate surface. This is so for example in the manufacture of compact discs for audio, video or data-storage purposes. In this case, the substrate surface directed towards the coating source is covered with a mask of a known type, which rests on the substrate to be coated. Apart from the materials conventionally used as a coating material, such as for example aluminium, occasionally gold or a gold-based alloy is used as a coating material in the PVD process in order to produce a gold coating. With masks used in series production, a gold coating builds up on the mask, which after exchanging of the mask is sent for reprocessing to retrieve the gold. In order to dissolve the gold coating, conventionally a mixture of concentrated nitric acid (HNO_3) and concentrated hydrochloric acid (HCl) known as aqua regia is used, or an alkali-cyanidic gold stripper solution is used. The gold dissolved in this process is recovered from the solution by means of a subsequent precipitation process.

A disadvantage of this reprocessing method is that it is not only the gold layer that dissolves, but the solvent also attacks the material of the mask. Then the mask composed for example of copper or a copper-based alloy is attacked by the wet-chemical solvent in such a manner that, after the repeated exchange of masks and reprocessing of the coating material thereon, the dimensional tolerances of the mask body are no longer retained, since the mask material has become severely worn at the defining edges of the mask.

The object of the present invention is to create a mask, in particular for selective PVD coating, in which even after repeated wet-chemical dissolution of a noble metal coating, in particular of a gold coating, the dimensions of the mask defining the coating configuration on the substrate are not variable.

This object is achieved according to the invention in that the mask has a mask base body consisting of copper or a copper-based alloy, which is covered with a protective coating consisting of the elements platinum, nickel or rhodium.

Preferably, in this case, the platinum coating is applied to the CD mask from a salt bath to a thickness of 0.5 μm to 10 μm by means of a high-temperature electrolysis process. The mask base body thus coated with a platinum protective layer is not chemically attacked even after repeated dissolving of gold layers by means of alkali-cyanidic gold stripper solutions. When aqua regia was used as a solvent, the platinum protective coating was advantageously not attacked until after repeated cleaning cycles, and then only locally.

Alternatively to the platinum layer, as a cheaper protective layer, a nickel coating 0.5 μm to 20 μm thick can be applied to the mask body. Here the nickel coating is advantageously precipitated from an aqueous solution by a galvanic process. By the use of an alkali-cyanidic gold stripper solution to remove a gold layer, the copper mask base body is not chemically attacked and retains its shape, which defines the coating positions.

Alternatively to the above-mentioned protective coatings, it has proved advantageous to apply to the mask base body a coating system consisting of at least two different materials.

A first coating system consists of a first 0.5 μm to 20 μm thick nickel layer applied to the mask base body. The first coating layer is covered with a second layer, preferably a 0.5 μm to 10 μm thick platinum layer, the layers each being applied by a galvanic process from aqueous solution. A protective coating thus formed advantageously resists dissolving by the cleaning of a gold-coated mask in an alkali-cyanidic gold stripper solution. Even if aqua regia is used, such a protective layer is not attacked until after repeated cleaning cycles, and then only locally.

An alternative coating system consists of a first nickel layer, 0.5 μm to 20 μm thick, preferably 0.5 μm to 5 μm thick, and a second coating layer of rhodium, 0.5 μm to 10 μm thick, preferably 0.5 μm to 1 μm thick, to which the nickel layer is applied. The coating with nickel and the coating with rhodium is effected by means of a galvanic process from aqueous solution.

In order to dissolve an approximately 1 mm thick gold coating applied to the protectively coated mask, the mask is laid in an alkali-cyanidic gold stripper solution (manufactured by Dimitron, reference "Gold Stripper 645"). After a dwell time of approx. 16 hours, all the gold will have dissolved from the mask surface. In a subsequent precipitation process, the gold in solution can be reprocessed and recovered as pure gold.

It has been found advantageous to use a mask according to the invention for PVD (plasma vapour deposition) coating methods according to claim 11, wherein for example disc-shaped substrates, such as CDs for example, are coated with a noble metal coating.

Further advantageous features of the invention are indicated in the subclaims.

The invention is explained more fully in the examples shown in Figures 1 to 4, in which:

- Figure 1a shows a PVD coating mask in a plan view,
- Figure 1b a section view of the mask shown in Figure 1a along the section line A-A' in Figure 1a,
- Figures 2a, a section view along the section line B-B' in Figure 1b of a mask provided with a single-layer protective coating, much enlarged,
- 2b
- Figure 2c a section view along the section line B-B' shown in Figure 1b, consisting of a dual-layer protective coating, much enlarged,
- Figure 3a a section view according to Figure 1b of an embodiment of a copper mask coated with rhodium, much enlarged,
- Figure 3b a section view according to Figure 2b of a copper mask coated with a dual-layer protective coating, much enlarged,
- Figure 4a a mask having a single-layer protective coating coated with gold, viewed in section and much enlarged.
- Figure 4b a mask having a dual-layer protective coating coated with gold, viewed in section and much enlarged.

The mask 2 shown in Figures 1a or 1b is intended for the selective coating of compact disc substrates, which are partially coated with a gold layer in a PVD coating plant.

The mask 2 shown substantially matches in its external dimensions the geometry of a CD. To this end, the circular mask 2 consists of an inner support 6 disposed concentrically with the mask and a peripheral support 4, with which the mask 2 rests on the substrate face (CD surface) to be coated. In the areas covered by the inner support 6 and the surrounding outer support 4, the CD surface is kept free of coating in the peripheral region and in a circular inner region. The outer support 4 and the inner support 6 are joined together rigidly by four stays 12a, 12b, 12c, 12d disposed at 90° intervals relative to one another. In order to coat a CD substrate, the mask 2 is deposited with the supports 4 and 6 on the substrate and the mask 2 with the adjacent CD substrate is positioned opposite a coating apparatus not shown in Figures 1a and 1b. The coating substances emitted from the coating apparatus in the direction of the CD substrate may hit the CD substrate surface through the holes formed between the stays 12a and 12b; 12b and 12c; 12c and 12d; 12d and 12a respectively, and may be deposited thereon for example as a sealed gold coating 20. In this case, the mask 2 is also covered with a gold coating on its surface associated with the coating surface.

The coating profile of a non-coated mask 2 is shown in Figures 2a, 2b, 2c and in Figures 3a, 3b. In Figure 2a, the protective coating 14a or 14b consists of a first coating layer of platinum or nickel (see Figure 2b), which is applied to the copper mask base body 3. An improvement of the embodiment shown in Figure 2b can be seen in Figure 2c, in which a further, preferably platinum, second coating layer 17 is applied, for example by a high-temperature electrolysis method from a salt bath, to the protective coating 14b applied in Figure 2b.

Instead of a single-layer protective coating 14a, 14b of platinum or nickel, as is shown in Figure 3a, a rhodium

layer 14d is applied to the mask base body 3, for example by means of a galvanic deposition process from aqueous solution. A further, cheaper dual-layer protective coating 11 consists, as Figure 3b shows, of a first nickel layer 14e applied to the mask base body 3 and a second rhodium layer 18 applied to the nickel layer 14e.

The gold coating 20 deposited on a mask 2 having a protective coating during the PVD coating process is shown in Figures 4a and 4b. Whereas single- or dual-layer protective coatings each have thicknesses in the μm range, the gold coating 20 reaches a thickness of approximately 1 mm after selective gold coating of CD substrates.

This layer thickness ratio is only indicated diagrammatically in the section views of layers shown in Figures 2a, 2b, 2c, 3a, 3b; 4a, 4b, and is not shown to scale.

Claims

1. Mask for covering areas of a substrate in the coating of substrates with a noble metal, preferably gold, in a vacuum-assisted coating process, wherein the mask (2) comprises a mask base body (3) preferably formed from copper, and wherein the mask base body (3) is coated with a protective coating (11, 14a-14g, 17, 18, 19), which comprises at least one coating layer (14a, 14b, 14d, 14f) consisting of one of the elements platinum, nickel or rhodium.
2. Mask according to claim 1, characterised in that the protective coating (11a, 11b, 11c) comprises at least two coating layers (14a, 17; 14e, 18; 14g, 19), the individual coating layers (14c, 17; 14e, 18; 14g, 19) consisting of one of the elements nickel, platinum or rhodium.
3. Mask according to claim 1 and/or 2, characterised in that the protective coating (11a, 11b, 11c) comprises a first coating layer (14c, 14e, 14g), preferably consisting of nickel, to which a second coating layer (17, 18, 19), preferably consisting of platinum or rhodium, is applied.
4. Mask according to at least one of claims 1 to 3, characterised in that the platinum coating (14a, 18) has a layer thickness of 0.5 μm to 15 μm , preferably 0.5 μm to 5 μm , and the rhodium layer (14d, 17) has a layer thickness of 0.5 μm to 15 μm , preferably 0.5 μm to 5 μm .
5. Mask according to at least one of claims 1 to 4, characterised in that the nickel layer (14b, 14c, 14e, 14f) has a layer thickness of 0.5 μm to 15 μm , preferably 1 μm to 10 μm .



6. Mask according to at least one of claims 1 to 5, characterised in that the protective coating (11a, 11b) consists of a first coating layer (14c) of nickel, preferably 0.5 μm to 5 μm thick, and of a second coating layer (17, 18) applied to the nickel layer (14c), preferably consisting of platinum or rhodium with a layer thickness of 0.5 μm to 1 μm .
7. Mask according to at least one of claims 1 to 6, characterised in that the protective layer (14a-14g, 17, 18, 19) is applied to the mask base body (3) by a galvanic deposition process from aqueous solution.
8. Method of manufacturing a mask according to claim 1, having a preferably low oxygen content copper base body (3), wherein the mask base body (3) is coated with a 0.5 μm to 10 μm , preferably 3 μm thick platinum coating (14a, 17) or rhodium coating (14d, 18) in a high-temperature electrolysis method from a salt bath.
9. Method of manufacturing a mask according to claim 1, in particular according to claim 8, having a preferably low oxygen-content copper mask base body (3), wherein a protective layer of nickel (14b, 14c, 14e, 14g) or rhodium (14d, 18, 14f, 19), preferably having a thickness of 0.5 μm to 10 μm , is applied to the mask base body (3) by a galvanic deposition process from aqueous solution.
10. Method according to claim 9, characterised in that a second coating layer (17, 18, 19) 0.5 μm to 10 μm thick, preferably 5 μm thick and consisting of platinum and/or rhodium is applied to the nickel coating (14c, 14e, 14g).
11. Use of a mask (2) according to one of claims 1 to 7 or of a mask (2) manufactured according to claims 8 to 10



for selective PVD coating, preferably of disc-shaped substrates with a noble metal coating or a thin coating of an alloy with a noble metal base, wherein the noble metal used is gold.

12. Use of a mask (2) according to claim 11, wherein in order to remove a gold coating applied as a coating material to a mask (2) in a coating chamber in the course of a vacuum sputtering process and/or sputtering process,

- the mask (2) is removed from the coating chamber and
- is immersed in an alkali-cyanidic gold stripper solution or a mixture containing hydrochloric acid (HCl) and nitric acid (HNO₃), so that the gold coating (20) is dissolved away from the protective coating (11c, 14f) by chemical reaction with the gold stripper solution or the acid mixture.

