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DENTAL ALLOY

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5 Claims

ABSTRACT OF THE DISCLOSURE

A precious alloy for use in dental frames on which ceramic coverings are formed by baking. Palladium is used in an amount ranging between 8 and 50 weight percent and indium is used in an amount ranging between 3 and 12 weight percent. The remainder of the alloy consists primarily of gold, or gold and silver, and small amounts of trace metals. With such an alloy, there is no need for the use of platinum as in the prior art dental alloys having the same desirable characteristics.

This invention relates to dental alloys, and more particularly to precious alloys for use in dental frames on which ceramic coverings are formed by baking.

There are hundreds of different alloys which are used in dental work for bridges, crowns, inlays, etc. A covering, having an appearance of a natural tooth, is usually provided on the exterior of the metal frame. The more common coverings are made of plastic which are spread on the frame and then hardened. The more preferred (although more expensive) covering is commonly referred to as "porcelain," although it is really a ceramic, initially in paste form, which is spread on the frame and then baked. To prevent cracking during the baking process, it is necessary that the metallic frame and the ceramic covering have approximately the same coefficient of thermal expansion.

The present invention relates to precious alloys used in dental frames on which ceramic coverings are formed by baking. A typical prior art alloy consists of gold (85% by weight), platinum (8%) and palladium (5%), with the remaining 2% by weight consisting of trace metals, e.g., copper, iron and tin which are used primarily for strengthening the alloy. Precious metals such as gold, platinum and palladium are used to obtain a white or yellow color which, when backing up the ceramic covering, contribute to the simulation of a natural tooth appearance. Also, such precious metals do not oxidize and thus do not discolor the ceramic. Because precious metals are generally soft, hardening agents are included in the alloy. Various combinations of different precious metals are used, in preference to an individual metal, primarily to obtain a coefficient of thermal expansion compatible with that of the ceramic, that is, a value which permits the two of them to be baked together without cracks forming in the ceramic.

Conventional dental alloys of this type are very expensive primarily because of their use of platinum. Although the day-to-day prices of gold, platinum and palladium vary, approximate respective prices per ounce are \$43, \$250 and \$36. It is apparent that even small quantities of platinum can add considerably to the overall cost of the alloy.

It is a general object of my invention to provide a precious alloy for use in dental frames which is cheaper than those of the prior art but of equal quality, and which has a coefficient of thermal expansion that is compatible with conventional ceramic coverings.

I have discovered that less platinum can be used and

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that platinum can be eliminated entirely, if the palladium content is increased, without sacrificing any of the desirable characteristics of the prior art alloy, provided that a sufficient quantity of indium is included in the alloy.

Indium with an approximate cost of \$4/ounce and palladium with an approximate cost of \$36/ounce obviously allow the alloy to be made at a reduced cost. In the prior art, platinum was required primarily to obtain a low coefficient of thermal expansion. To harden the alloy, trace metals such as tin and copper were used. Although greater amounts of palladium (instead of platinum) could be used to lower the coefficient of thermal expansion, in the prior art there were no known satisfactory trace metals which could sufficiently harden the alloy with large amounts of palladium. I have found that larger amounts of palladium can be used, instead of platinum, and that the alloy can be sufficiently hardened by using a prescribed amount of indium. The combination results in a coefficient of thermal expansion compatible with and approximately equal to those of conventional ceramic materials used for coverings. The coefficient of thermal expansion for such a ceramic material is typically in the range between $.74 \times 10^{-3}$ and $.88 \times 10^{-3}$ inch/600° C./inch.

It is a feature of my invention to include in a precious alloy used in dental frames on which ceramic coverings are formed palladium in the amount of 8–50 weight percent and indium in the amount of 3–12 weight percent. (As used in the specification and claims, the term "precious alloy" is an alloy at least 95% by weight of which is comprised of gold, silver, indium, gallium, platinum, palladium, ruthenium, rhodium, osmium, and iridium.)

As set forth above, a critical feature of the invention is the inclusion of 8–50 weight percent of palladium, and another critical feature is the inclusion of 3–12 weight percent of indium. When the minimum quantities are used, preferably at least 84% of the alloy will be of gold, or a combination of gold and silver. The remaining 5% can include traces of other metals, such as copper, nickel, tin, or any other element which improves the characteristics of the alloy as is known in the art. When the maximum values of palladium and indium are used (a total of 62 weight percent), at least 33% of the remainder of the alloy should be gold, or a combination of gold and silver. When a combination of gold and silver is used, it is desirable that the silver not exceed 25% of the total weight to prevent the ceramic from turning green during baking.

Although platinum can be used in place of the gold, or the gold and silver, the primary advantage of the invention resides in avoiding the need for platinum. If palladium and indium are used in the quantities set forth above, the alloy has a coefficient of thermal expansion approximately equal to $.83 \times 10^{-3}$ inch/600° C./inch (to match that of the most commonly used ceramic materials), sufficient hardness, and a satisfactory color.

I have also found that, if the amount of palladium used exceeds 30% of the overall weight, the weight of the indium is preferably in the range 16–25% of the weight of the palladium. If excessive indium is used, the alloy may become brittle, especially when small amounts of palladium are used.

I have found that the use of indium, in the range 3–12 weight percent, is critical to the objects of this invention. Lower amounts of indium may serve to improve the casting characteristics of alloys of this character but are insufficient for the purpose of achieving sufficient hardness. Amounts of indium in excess of 12% result in unsatisfactory alloys due to brittleness.

Two illustrative alloys in accordance with the principles of my invention are as follows, where the number follow-

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ing each element represents the amount of that element, by weight percent, in the alloy:

Example 1: Gold (75.9), palladium (17), indium (7), copper (0.1).

Example 2: Gold (49.9), palladium (30), silver (14), indium (6), copper (0.1).

The alloy of the first example is yellowish in color, while the alloy of the second example is white. In the second example, less gold is used than in the first, and in addition silver is included. Silver, of course, is one of the cheapest of the various precious metals and further reduces the overall cost. The small trace of copper in each case greatly improves the tensile strength of the alloy.

I have found that for the best results the palladium and gold (or, gold and silver) should first be melted together, and the indium then added. The addition of the indium to the melt prevents its oxidation.

After the relative amounts of palladium and indium are determined, many different alloys can be formed depending on the relative amounts of gold and silver, other precious metals and any trace metals which are used in accordance with standard practice. The use of more silver raises the coefficient of thermal expansion of the alloy. The use of more gold or silver lowers the melting point of the alloy.

An added advantage of some of the alloys constructed in accordance with the principles of my invention, e.g., the first illustrative example above, is that their densities may be less than those of the prior art dental alloys. This permits the use of less alloy for any given size frame, which results in an additional savings due to the use of less material, not to mention the fact that the material is less costly in the first place.

In the prior art, it has generally been necessary to roughen the dental frame prior to placing the ceramic paste on it in order that the ceramic covering, after baking, properly adhere to the frame. Another advantage of my invention is that the use of indium in the range 3-12 weight percent does not require roughening the frame in order that the covering adhere to it. It is believed that the indium reacts chemically with conventional ceramic coverings, such as those sold under the trademarks Ceramco, Micro Bond, Thermalite, Vita and Gold Bond, and thereby improves the binding of the covering to the frame.

Although the invention has been described with reference to particular embodiments, it is to be understood that

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these embodiments are merely illustrative of the application of the principles of the invention. Numerous modifications may be made therein without departing from the spirit and scope of the invention.

What is claimed is:

1. A dental alloy consisting essentially of more than 95 weight percent of a precious alloy, said precious alloy including 8-50 weight percent of palladium, 3-12 weight percent of indium and at least 33 weight percent of gold and silver and having a co-efficient of thermal expansion compatible with bakeable ceramic coverings, said alloy having trace metals in amounts less than 5 weight percent, said amounts insufficient to discolor said ceramic coverings when baked thereon.

2. An alloy in accordance with claim 1 further including at least 33 weight percent of gold.

3. An alloy in accordance with claim 1 wherein said silver is less than 25 weight percent of the alloy.

4. An alloy in accordance with claim 3 wherein said palladium comprises at least 30 weight percent of the alloy, and the weight percent of said indium is in the range 16-25 percent of the weight of said palladium.

5. An alloy in accordance with claim 1 wherein said alloy includes not more than 0.1 weight percent of trace metals.

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