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Description

This application relates to a dental material and method for reinforcing a dental metal structure in forming, repairing or reinforcing a dental restoration.

In crown and bridge prosthodontics, a wide diversification of retainers and pontics can be used in various combinations for constructing a bridge. A ceramic to metal restoration uses a framework of metal as reinforcement for the crown and bridge upon which is applied a fired-on coating of a ceramic material such as porcelain. The framework of metal may either be cast or formed from prefabricated units of preformed copings and pontics. In accordance with present practice a framework may be altered by soldering, but otherwise cannot be modified or reinforced without involving investment and casting operations. Present practice is limited because of the unavailability of commercial materials with which to build up or extend the framework. To reinforce a framework without investment and casting requires adding material to the framework which upon heat treatment will become an integral part of the framework. The material must be capable of being molded into a desired shape and must be self-supporting in the molded configuration as well as capable of retaining the shape in which it was molded under heat treatment. To be able to shape the material into a desired configuration, the material should be relatively soft and workable. Under heat treatment, the material should solidify into a rigid mass of metal without losing the shape in which it was molded prior to heat treatment. The material should fuse to the metal framework and should have a hardness characteristic of at least equal but preferably greater than the hardness of the material before heat treatment.

Such a material could be used, for example, to build up a cervical shoulder around a retaining member at the gingival margin without the need for investment or casting. For example, a finishing shoulder can be formed around a prefabricated metal coping which was preformed without a shoulder margin. The finishing shoulder can be molded into any shape by the dental technician. Likewise, the material can be used to build metal cusps upon a metal coping before ceramic porcelain is added to provide buccal and/or lingual cusp reinforcement. The material may also be used to strengthen joints at predetermined locations in the framework or for general bridgework repair. The latter is, at present, relatively impossible. Heretofore, the dentist, and dental technical were essentially limited to use of cast dental structures and to materials useful as solders or fluxes. Neither the conventional solder nor flux is capable of being molded into a self-supporting configuration nor is either material capable of retaining a shape under heat treatment. Soldering alloys are, in fact, designed to melt and flow freely under the heat of a soldering flame and function to join metals by fusion. A flux is a non-oxidizing agent.

Although no dental material is presently commercially available for reinforcing a dental restoration, there have been attempts in the past to form such a material. All such attempts are based on using a composition which solidifies into a solid mass upon being heat treated and suffers from substantial shrinkage.

In Applicant's EP-A- 87 117 776 a dental material composed of metal particles is disclosed for forming, repairing or reinforcing a dental restoration. The composition of metal particles are loose granular particles, preferably held together with a binder, to form a paste or putty constituency which facilitates using the composition as a build-up material for reinforcing the framework of a dental restoration. The material is intended to be applied to a metal retainer, shaped into a desired configuration and heat treated. A porous sponge-like structure is formed as a result of the heat treatment having the shape it was given prior to heat treatment. If desired, a low melting temperature filler material may be melted into the sponge-like structure to form an integral solid mass.

Under certain circumstances it is difficult, impractical or undesirable to build up the dental material into the final shape with exacting detail prior to heat treatment. This is due to the difficulty in carving the material to form curves and shapes having accurate contours with any detailed precision. Instead, it is preferable to modify or reshape the material after it is heat treated, either by grinding, pressing or burnishing. The porous structure formed heretofore was found to be vulnerable to breakage and/or to chipping or flaking during any post-cold working operation.

It has been discovered in accordance with the present invention that by the judicious selection of the particle composition of the components in forming the dental material, and the volume relationship between components based upon their specific gravities, a porous structure with a desired void volume may be formed which, upon heat treatment, can be readily reshaped with a minimal degree of susceptibility to breakage or chipping.

SUMMARY OF THE INVENTION

The dental material of the present invention is composed of a composition of metal particles which upon heat treatment at a predetermined heat treatment temperature forms a porous sponge-like structure having a void volume of 20-80 % and being suitable for use in forming, repairing or reinforcing a dental restoration, comprising relatively large metal particles of a first high fusing temperature metal component having a particle size below about 100μm and a melting point above said heat treatment temperature, and a second low fusing temperature metal component of smaller size particles which substantially melt during said heat treatment for binding the particles of said high fusing temperature metal so as to form said porous sponge-like structure of said high fusing temperature metal particles interconnected by the melted low fusing metal component and with the second low fusing temperature metal component, being at least equal in percent by volume relative to the high fusing temperature metal first component in the porous sponge-like structure.

The method of the present invention comprises forming a dental material from a composition of metal particles as defined above and heat treating said composition at a temperature above the melting temperature of said low fusing component, an open porous structure of metal is formed having a total void volume of between 20-80%. Said porous structure may then be cold worked into a desired predetermined shape for forming, reinforcing or repairing a dental restoration.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The dental material of the present invention is a composition of metal particles which can be molded and heat treated into a desired self-supporting shape for forming a dental reinforced structure or for repairing a dental restoration. The dental material is composed of a composition of metal particles containing a high fusing temperature, metal component of a single metal or a metal alloy, preferably of precious metals, and a low fusing temperature metal component. The low fusing temperature metal component should consist of a single metal or metal alloy in the form of particles or clad to the particles of the high fusing temperature, precious metal component. Preferably the low fusing metal component is present in the composition of metal particles in an amount greater than the high fusing component. The melting temperature of the high fusing temperature metal component should be higher than the melting temperature of the low fusing temperature metal component, and higher than the temperature at which the material is heat treated. Under heat treatment, the low fusing temperature component melts to fuse the high temperature particles together at its point of contact to form a porous sponge-like structure which retains the shape it is given prior to heat treatment.

A binder or other suitable carrying vehicle may be added to the composition of metal particles in forming the dental material of the present invention to give the material a paste or putty-like constituency. This should make the material easier with which to work. A binder should be selected which will volatize during heat treatment without lLeaving a residue. Any suitable organic resinous or synthetic resinous material is acceptable such as, for example, ethylene or polyethylene glycol. In addition to a binder, a flux such as borax may be added to form the dental material of the present invention. The flux eliminates the formation of oxides.

The composition of metals forming the dental material should be bio-compatible for use in the mouth. Accordingly, precious metals and precious metal alloys are preferred although not essential. The precious metals may also be used in combination with non-precious metals. In the foregoing embodiments of the invention, the high fusing temperature metal composition is primarily composed of a combination of from 0 to 100% platinum and from 100 to 0% palladium, with or without other constituents such as gold. However, the high fusing component may be a single metal or a mixture of different particles of different metals. Gold may be added to the high fusing temperature metal composition to increase the affinity of the particles of the high fusing temperature component to the low fusing temperature component. Other metals may be added to the high fusing component such as copper, aluminium, iridium, indium, ruthenium, nickel, gallium, rhenium and/or iron.

The particles of the low fusing temperature metal are preferably composed of a gold alloy with gold as the major constituent or entirely of gold. The preference for gold as the major constituent of the low fusing component is based on its known characteristics of workability, non-oxidizing property and its color.

The size of the particle of the high fusing temperature metal component is an important characteristic of the present invention. Best results are achieved when the particle size of the high fusing temperature component is below about 100 microns and preferably below 74 microns. The high fusing temperature component particles should also be larger in size than the particle size of the low fusing component, and preferably about 2-10 times larger than the particle size of the low fusing component. The optimum size is about 5-10 times larger than the low fusing component. The low fusing component is preferably no larger than 50 microns in size, and optimally below 25 microns in size.

When the low fusing component is cladded to the particles of high fusing particles, the latter should also be much larger in size based upon relative thicknesses between the clad components. The shape of the particles of the high fusing component is considered important to the present invention, but is not a critical characteristic. Irregularly shaped particles in the form of flakes appear to function best. An irregular shape allows the particles to form a mesh or open interlocking network of particles. The low fusing metal component fuses the particles of the high fusing temperature at the contact points in the open network to form a porous sponge-like mass under heat treatment. Any shape is acceptable including a spherical shape, although strips and irregularly contoured shapes (particularly a crescent shape) is preferred.

Although the material of the present invention is a composition of metal particles, the method of forming the particles is not critical to the present invention and, as stated earlier, the low fusing component particles may be cladded to the high fusing component particles to form a composite of a high fusing temperature component and a low fusing temperature component. The cladded particles may have one component totally encapsulating the other or only partially covering one another. Cladded particles may be formed, for example, from multiple layered sheets which may have been laminated. Various other known deposition processes may also be used to form layered sheets or to encapsulate the particles one within the other including, for example, electrodeposition and cathode sputtering. Where the metal particles are cladded to one another, the proportion of the high fusing component to the low fusing component in the total composition would be based on the difference in the thickness between the cladded metals. Preferably the thickness of the low fusing component should be in a range of 8 to 15 microns for reasons which will be discussed hereafter.

The method of the present invention comprises forming a dental material composition of metal particles with a high fusing temperature component, as heretofore defined, in combination with a low fusing temperature component, as heretofore defined. The low fusing temperature component is intended to function primarily as a soldering agent for fusing the particles of the high fusing temperature metal together at their points of contact upon heat treatment. The concentration and volume percent of low fusing temperature metal particles will, however, control the void volume in the porous structure formed by heat treatment. A porous structure having a void volume of 20-80% is preferred with a void volume of 40-60% being optimal. Also, to develop a sponge-like structure which is easily shaped through cold working, such as by grinding, burnishing and/or pressing, the sponge particles have to be well fused together and relatively rigid. Accordingly, the volume of the low fusing component in the composition should be selected to produce a sponge having a desired void volume characteristic which will enable the porous structure to be reshaped. When the high fusing component is palladium or an alloy containing palladium in a range of from 35-100% palladium, the low fusing temperature component should represent 40-70% by volume of the heat treated porous structure, and preferably between 45-60% by volume of the porous structure. Optimally, the volume of the low fusing component in the porous structure should be at least approximately equal to, and preferably greater than the volume of the high fusing component. Moreover, the low fusing temperature metal component in the metal composition prior to heat treatment should also be, by weight percent, a range from about equal to, but preferably greater than the weight percent of the high fusing component in the composition. This generally results in a porous structure with a 20 - 80 %, optimally 40-60% void volume. The percent of metal by volume in the porous structure is derived from the weight percent of metal particles in the composition prior to heat treatment and by their specific gravities. The following six examples consisting of two groups, A and B of three different samples, are given for illustrative purposes (example I).

Sample	Percent by weight in composition before heat treatment		Percent by volume in sponge after heat treatment	
	High fusing metal	Low fusing metal	High fusing metal	Low fusing metal
Group A 1.	33.76%	66.24%	45%	55%
2.	53.63%	46.37%	65%	35%
3.	21.07%	78.93%	30%	70%
Group B 1.	47.26%	52.74%	45%	55%
2.	67.36%	32.64%	65%	35%
3.	32.26%	67.74%	30%	70%

In samples 1-3 of Group A, the high fusing component is palladium and the low fusing component is gold, whereas in Group B, the high fusing component is platinum and the low fusing component is gold. The particle sizes of the high fusing component vary between 10 to 70 microns for each Group A and B to provide the percent by weight indicated. The gold component is pure gold with particles of between 5 to 25 microns. The heat treatment temperature is 1100°C. The specific gravity for the palladium component is 12 gm/cm^3 (grams per cubic centimeter) and the specific gravity for platinum is 21.45 gm/cm^3. The different groups are based on the differences in specific gravity for the high fusing components and, as such, will affect the weight relationship before heat treatment.

The total void space for the product of samples 1 and 4 is 55%, for samples 2 and 5, it is 65%, and for samples 3 and 6, it is 35%.

Samples 1 and 4 form a sponge product which can be readily cold worked by either burnishing, pressing or grinding without breaking off particles or flaking. This is also true for samples 3 and 6, but they undergo substantial shrinkage during sintering. Samples 2 and 5 produce a sponge-like product which tends to break and flake under cold working applications, such as burnishing, grinding and pressing. Accordingly, the preferred materials provide a higher percent by volume of the low fusing component in the sponge, and a range of from nearly equal to a much greater percentage by weight of the low fusing component in the composition before heat treatment.

A binder and/or fluxing agent is added to the dental material composition before it is used as a build-up material. A binder may be added, as earlier explained, to give the dental material composition a paste-like clay constituency which should make the material easier to work with. The dental material composition is applied to a dental structure, such as a metal coping or bridge, to add reinforcement to the structure at desired specific locations or to extend the structure, etc. The dental material may be applied to the structure by a brush or spatula and burnished or molded by hand into a desired shape. The dental structure, including the dental material, is then heat treated at a preselected heat treatment temperature by subjecting it to the flame of a Bunsen burner or by sintering in a furnace at a temperature below the melting temperature of the high fusing temperature component. The melting temperature of the high fusing temperature component should be above the selected heat treatment temperature which is usually a temperature below 1300°C and preferably between about 1075°C to 1175°C, although any desired temperature may be used as the heat treatment temperature provided it will melt the low fusing temperature metal component. Heat treatment causes the dental material composition to form a porous structure in the form of an open network of interconnected metal particles of generally sponge-like appearance which is fused to the dental structure. The porous sponge-like mass of metal retains the shape it was given prior to heat treatment with the degree of shrinkage during heat treatment related to the ratio of the low fusing temperature component to the high fusing temperature component. Although, in general, the lower the concentration of low fusing component, the lower the shrinkage, it does not necessarily follow that shrinkage is entirely undesirable and that therefore, in some cases, a higher ratio of low to high temperature component would be desirable. It may, for example, be desirable to control the amount of shrinkage in the metal sponge so as to tailor to the shrinkage to the anticipated shrinkage in the porcelain material when baked in the furnace during the fabrication of a porcelain to metal restoration. In the latter case, the volume percent of low fusing component in the sponge should be higher than the high fusing component. It may also be desirable to give the metal porous structure a "gold" look. This is preferably accomplished by using a low fusing component of gold or gold alloy with a substantially higher proportion of low fusing component relative to the high fusing component in the porous structure. A gold or gold alloy low fusing component is preferred for use with a palladium or palladium alloy high fusing component.

After heat treatment particles of filler having a low melting temperature are added to the porous mass of metal and heat treated to cause the filler particles to melt into the sponge-like porous mass for forming a solid reinforced structure. The particles of filler are preferably metal particles of gold. Heat treatment of the filler particles can be carried out at the same heat treatment temperature as originally carried out to form the porous mass. The low fusing temperature metal in the porous mass was melted during heat treatment to form an alloy with the high fusing metal at the points of contact where the low fusing component solidifies. The metal alloy has a higher melting temperature than the melting temperature of the original low fusing component and, accordingly, it will not remelt upon renewed heat treatment at the same temperature. Alternatively, filler particles can be selected with a different melting temperature than the original melting temperature of the low fusing metal component. For example, the filler particles can be gold and the low fusing metal a gold alloy, or they can both be pure gold or gold alloys. Other metals may also be used. Moreover, the porous sponge may be filled with filler particles of a ceramic composition such as porcelain, where strength is not required and particularly for repair of a chipped porcelain restoration.

The low fusing metal component may consist of a single metal such as pure gold or an alloy thereof or of more than one metal alloy in combination. When the low fusing component is plated onto the particles of the high fusing component to form cladded particles, it is important that the thickness of the low fusing component be small relative to the thickness of the high fusing component. The preferred thickness is between 8-15 microns. The high fusing metal component may be a composition of gold, platinum and palladium with minor additions of other constituent elements, with the combination of palladium and/or platinum being the major constituent.

It should be understood that the invention is not to be construed as limited to any given dental application for the material. The material may, for example, be added to a dental framework after the porcelain has been fired. If, for example, a crown is too short at the margin, this material may be used to extend the crown. Accordingly, the word "reinforce" is not to be given a narrow interpretation, but is instead to be given a much broader definition so that it specifically encompasses the idea of increasing the size and physical dimensions of the framework by simply adding to or extending the framework. In fact, the whole dental restoration -- be it a crown, inlay or onlay -- can be made with the dental material of the present invention. In the game manner, the material of the present invention may be used to fill a space between adjacent teeth upon which a fired-on ceramic veneer may be applied, if desired, or to form a coping for a dental restoration.

EXAMPLE II

	Percent by weight in composition before heat treatment		Percent by volume in sponge after heat treatment	
	High fusing metal	Low fusing metal	High fusing metal	Low fusing metal
Group A				
1.	38.70%	61.60%	45%	55%
2.	58.59%	41.41%	65%	35%
3.	24.61%	75.39%	30%	70%
Group B				
4.	52.29%	47.74%	45%	55%
5.	71.63%	28.37%	65%	35%
6.	36.81%	63.19%	30%	70%

The high fusing component in Group A is palladium and in Group B is platinum. The low fusing metal in both groups is a gold-silver alloy with a specific gravity of 15.78 and a composition of about 26.5% silver and 73.5% gold (by weight). The samples show that in order to get similar sponge structure both in percent by volume after heat treatment and total void space different weight proportions based on the specific gravity of the components must be used.

Accordingly, from the above example and the example on page 16 the preferred range for the the low fusing component to form a sponge product which can be cold worked varies from about 47% (Example II, B4) by weight to about 66% by weight (example I, A1). If the high fusing metal is a relatively soft metal or alloy of palladium with a low specific gravity relative to the specific gravity of platinum, the low fusing component should be above 50% by weight and up to 66% by weight to form a desired sponge product which can be readily cold worked.

The total void space for the sponge product in samples 1;4 are similar to those of 1;4 in the example on page 16; the same is true for products 2;5 and 3;6 in both samples.

EXAMPLE III

Example of heat treatment and the thermal behaviour.

A typical porcelain to metal restoration is fired at up to about 1000 °C. This means that the metal understructure should be stable to about 1100 °C in order not to deform during porcelain firing. In cases where two restorations have to be soldered together prior to porcelain firing, the soldering should be stable to about 1100 °C. This means that the build up material of the subject invention should be stable to about 1150 °C preferably even at 1170 °C.

Sample: High fusing metal 90% Palladium and 10% Gold, with a melting point of about 1540 °C. Low fusing metal - 100% Gold, melting point 1063 °C. A mixture of about 40% high fusing particles and 60% low fusing particles is used.

The heat treatment may be in a furnace or on an open flame. In the furnace at 1000 °C with 2 min. holding time there is sufficient melting of the gold to create connections between the high temperature particles to form a moldable sponge. A temperature of 1100 °C preferred.

Due to diffusion of Palladium from the high fusing particles to the low fusing material the temperature of the low fusing material rises to about 1150 °C. A longer heat treatment at 1050 °C for 5 min. will increase the thermal stability of the low fusing component and the sponge will not change during subsequent heatings of up to about 1180 °C.

If a second low fusing metal, like pure gold, is used to fill the sponge at about 1070 °C, the newly formed dental material will be stable up to about 1160 °C after a heat treatment of 1050 °C for 5 min. This will allow soldering at about 1100 °C.

EXAMPLE IV

Example of a composition to produce a preferred total void space of about 55% of the total volume:
High fusing component: 65% Palladium, 30% Gold, 2% Platinum, 1% Silver, 2% other metals and fluxes. Particle size 2-75 microns with 50% of them 25-55 microns.
Low fusing component: 95% Gold 5% Silver, particles 1-22 microns with 50% 7-15 microns.
Total mixture by weight: 60% low fusing, 40% high fusing.

EXAMPLE V

A composition to be used at a lower temperature, to build up or repair a restoration:

High fusing component -	30% gold 70% palladium
Low fusing component -	40% silver 60% gold

A second low fusing component may be used to fill the sponge.

For different purposes different compositions may be used. The low fusing component may be of Aluminum or other low temperature metals providing the heat treatment is at a temperature of higher than their melting points and the melting points of the high fusing temperature is above these temperatures.

Claims

1. A composition of metal particles which upon heat treatment at a preselected temperature forms a porous sponge-like structure suitable for forming, repairing or reinforcing a dental restoration, said composition including metal particles of a first high fusing temperature metal component having a particle size below about 100 μm and a melting point above the selected heat treatment temperature and metal particles of a second low fusing temperature metal component having a melting point below said heat treatment temperature, and being smaller in size than the high fusing metal particles, said porous sponge-like structure having a total void volume of 20 - 80 % and with the low fusing metal

component in the composition of metal particles being present in an amount by weight greater than the high fusing component such that in the porous sponge-like structure the low fusing metal component is at least equal in percent by volume to the high fusing metal component.

2. A composition, as defined in claim 1, wherein the particles of the high fusing metal component are irregularly shaped.

3. A composition as defined in claim 1 or 2, wherein said high fusing metal is palladium or platinum and said low fusing metal is gold or a gold alloy in which gold is the major constituent.

4. A composition, as defined in any one of claims 1 to 3, wherein said porous sponge-like structure has a total void volume of about 40 % to 60 %.

5. A composition, as defined in any one of claims 1 to 4, wherein said high fusing temperature metal component is composed of 0 - 100 % platinum and 100 to 0 % palladium with or without gold as further constituent.

6. A composition, as defined in claim 5, wherein said low fusing temperature metal component is gold or a gold alloy.

7. A composition, as defined in anyone of claims 1 to 6, wherein said high fusing temperature metal particles are at least two times larger in size than the low fusing temperature metal component.

8. A composition, as defined in claim 7, wherein said high fusing temperature metal particles are at least five times larger in size than the low fusing temperature metal particles.

9. A composition, as defined in anyone of the preceding claims, wherein said composition of metal particles further comprises a binder to give the material a paste-like constituency.

10. A method of forming a dental material comprising the steps of forming a composition as defined in anyone of claims 1 to 9 and heat treating said composition at a temperature above the melting temperature of said low fusing component, so that a dental material having an open porous structure of metal is formed having a total void volume of between 20 % and 80 %.

11. A method as defined in claim 10, wherein the method further comprises cold working said porous structure into a desired predetermined shape for forming, reinforcing or repairing a dental structure.

12. A method, as defined in claims 10 or 11, wherein said low fusing component is selected by weight percent to be approximately equal to or greater than the weight percent of said high fusing component in said composition.

13. A method, as defined in any one of claims 10 to 12, wherein said high fusing temperature metal component is composed of 0 - 100 % platinum and 100 to 0 % palladium with or without gold as further constituent.

14. A dental material obtainable according to anyone of claims 10 to 13.

Patentansprüche

1. Metallpartikelzusammensetzung, welche bei Wärmebehandlung bei einer vorbestimmten Temperatur, eine poröse, schwammartige Struktur bildet, die zur Bildung, Reparatur oder Verstärkung einer Zahnrekonstruktion geeignet ist, wobei die Zusammensetzung Metallpartikel einer ersten Metallkomponente mit hoher Schmelztemperatur, die eine Teilchengröße von weniger als etwa 100 µm und einen Schmelzpunkt oberhalb der vorbestimmten Temperatur der Wärmebehandlung aufweist, und Metallpartikel einer zweiten Metallkompoente mit niedriger Schmelztemperatur umfaßt, die einen Schmelzpunkt unterhalb der erwähnten Tempertur der Wärmebehandlung und eine geringere Größe als die hochschmelzenden Metallpartikel aufweisen, wobei die poröse, schwammartige Struktur ein Gesamthohlraumvolumen von 20 - 80 % aufweist und wobei die niedrigschmelzende Metallkomponente in der

Metallpartikelzusammensetzung in einer auf das Gewicht bezogenen Menge vorhanden ist, die großer ist als diejenige der hochschmelzenden Metallkomponente, derart, daß in der porösen, schwammartigen Struktur die niedrigschmelzende Metallkomponente in Volumenprozent zumindest gleich der hochschmelzenden Metallkomponente ist.

2. Zusammensetzung nach Anspruch 1, wobei die Partikel der hochschmelzenden Metallkomponente unregelmäßige Gestalt besitzen.

3. Zusammensetzung nach Anspruch 1 oder 2, wobei es sich bei dem hochschmelzenden Metall um Palladium oder Platin und bei dem niedrigschmelzenden Metall um Gold oder eine Goldlegierung, in der Gold den Hauptbestandteil bildet, handelt.

4. Zusammensetzung nach einem der Ansprüche 1 bis 3, wobei die poröse, schwammartige Struktur ein Gesamthohlraumvolumen von etwa 40 bis 60 % besitzt.

5. Zusammensetzung nach einem der Ansprüche 1 bis 4, wobei die Metallkomponente mit hoher Schmelztemperatur aus 0 - 100 % Platin und 100 bis 0 % Palladium mit oder ohne Gold als weiterem Bestandteil besteht.

6. Zusammensetzung nach Anspruch 5, wobei es sich bei der Metallkomponente mit niedriger Schmelztemperatur um Gold oder eine Goldlegierung handelt.

7. Zusammensetzung nach einem der Ansprüche 1 bis 6, wobei die Metallpartikel mit hoher Schmelztemperatur wenigstens zweimal größer sind als die der Metallkomponente mit niedriger Schmelztemperatur.

8. Zusammensetzung nach Anspruch 7, wobei die Metallpartikel mit hoher Schmelztemperatur wenigstens fünfmal größer sind als die Metallpartikel mit niedriger Schmelztemperatur.

9. Zusammensetzung nach einem der vorhergehenden Ansprüche, wobei die Zusammensetzung der Metallpartikel zusätzlich ein Bindemittel umfaßt, um dem Material eine pastenartige Konsistenz zu verleihen.

10. Verfahren zur Bildung eines Dentalmaterials, wobei man eine wie in einem der Ansprüche 1 bis 9 definierte Zusammensetzung bildet und die Zusammensetzung bei einer Temperatur oberhalb der Schmelztemperatur der niedrigschmelzenden Komponente einer Wärmebehandlung unterzieht, so daß ein Dentalmaterial mit einer offenporigen Metallstruktur gebildet wird, das ein Gesamthohlraumvolumen zwischen 20 und 80 % aufweist.

11. Verfahren nach Anspruch 10, das zusätzlich eine Kaltbearbeitung der porösen Struktur in eine gewünschte vorbestimmte Gestalt zur Bildung, Verstärkung oder Reparatur einer Dentalstruktur umfaßt.

12. Verfahren nach Anspruch 10 oder 11, wobei die Menge der niedrigschmelzenden Komponente in Gewichtsprozent so gewählt wird, daß sie etwa gleich der oder größer als die Menge an hochschmelzender Komponente in Gewichtsprozent in der Zusammensetzung ist.

13. Verfahren nach einem der Ansprüche 10 bis 12, wobei die Metallkomponente mit hoher Schmelztemperatur aus 0 bis 100 % Platin und 100 bis 0 % Palladium mit oder ohne Gold als weiterem Bestandteil besteht.

14. Dentalmaterial, erhältlich nach einem der Ansprüche 10 bis 13.

Revendications

1. Composition de particules métalliques qui pendant un traitement thermique à une température présélectionnée forme une structure poreuse analogue à une éponge appropriée pour former, réparer ou renforcer une restauration dentaire, ladite composition comprenant des particules métalliques d'un premier composant métallique à température de fusion élevée ayant une granulométrie inférieure à environ 100 µm et un point de fusion au-dessus de la température de traitement thermique choisie et des particules métalliques d'un second composant métallique à basse température de fusion ayant un point de fusion inférieur à ladite température de traitement thermique, et ayant une granulométrie plus faible que les particules métalliques à température de fusion élevée, ladite structure poreuse analogue à une éponge ayant un volume total de vide de 20 à 80%, et le composant métallique à basse température de fusion dans la composition de particules métalliques étant présent en une quantité pondérale supérieure au composant à température de fusion élevée de sorte que dans la structure poreuse analogue à une éponge le composant métallique à basse température de fusion soit au moins égal en pourcentage volumique au composant métallique à température de fusion élevée.

2. Composition selon la revendication 1, dans laquelle les particules du composant métallique à température de fusion élevée ont une forme irrégulière.

3. Composition selon l'une des revendications 1 ou 2, dans laquelle ledit métal à température de fusion élevée est du palladium ou du platine et ledit métal à basse température de fusion est de l'or ou un alliage d'or dans lequel l'or est le constituant principal.

4. Composition selon l'une quelconque des revendications 1 à 3, dans laquelle ladite structure analogue à une éponge possède un volume total de vide d'environ 40% à 60%.

5. Composition selon l'une quelconque des revendications 1 à 4, dans laquelle ledit composant métallique à température de fusion élevée est composé de 0 à 100% de platine et de 100 à 0% de palladium avec ou sans or comme constituant supplémentaire.

6. Composition selon la revendication 5, dans laquelle ledit composant métallique à basse température de fusion est de l'or ou un alliage d'or.

7. Composition selon l'une quelconque des revendications 1 à 6, dans laquelle lesdites particules métalliques à température de fusion élevée sont au moins deux fois plus grandes en taille que le composant métallique à basse température de fusion.

8. Composition selon la revendication 7, dans laquelle lesdites particules métalliques à température de fusion élevée sont au moins cinq fois plus grandes en taille que les particules métalliques à basse température de fusion.

9. Composition selon l'une quelconque des revendications précédentes, dans laquelle ladite composition de particules métalliques comprend de plus un liant pour donner au matériau une consistance analogue à une pâte.

10. Procédé de formation de matériau dentaire comprenant les étapes consistant à former une composition telle que définie dans l'une quelconque des revendications 1 à 9 et à traiter thermiquement ladite composition à une température au-dessus de la température de fusion dudit composant à basse température de fusion, de façon à former un matériau dentaire ayant une structure poreuse ouverte de métal ayant un volume total de vide compris entre 20% et 80%.

11. Procédé selon la revendication 10, dans lequel le procédé comprend de plus le traitement à froid de ladite structure poreuse en une forme prédéterminée souhaitée pour former, renforcer ou réparer une structure dentaire.

12. Procédé selon l'une des revendications 10 ou 11, dans lequel le pourcentage pondéral dudit composant à basse température de fusion est choisi de façon à être approximativement égal ou supérieur au pourcentage pondéral dudit composant à température de fusion élevée dans ladite composition.

13. Procédé tel que défini dans l'une quelconque des revendications 10 à 12, dans lequel ledit composant métallique à température de fusion élevée est composé de 0 à 100% de platine et de 100 à 0% de palladium avec ou sans or comme constituant supplémentaire.

14. Matériau dentaire que l'on peut obtenir selon l'une quelconque des revendications 10 à 13.