The material and method for making a textured flexible sheet of a precious metal involves using a precious metal paste, having a consistency whereby the precious metal paste may be brushed onto a textured surface, to create a thin and flexible precious metal veneer. The precious metal paste is applied to a textured surface and allowed to dry, becoming a veneer sheet of a precious metal material having a flexible, leather-like consistency. Once dried, the precious metal material is removed from the substrate in the form of a flexible precious metal veneer having a textured surface. The veneer retains the properties of a precious metal material from which it was made, including amount of shrinkage and range of firing temperatures. The precious metal veneer can be formed into, or applied to, an article of jewelry or artwork or another article, and sintered to become a piece of fine precious metal.
TEXTURED FLEXIBLE SHEET OF PRECIOUS METAL

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims the benefit of U.S. Provisional Patent Application Ser. No. 60/566,176, filed Apr. 29, 2004.

BACKGROUND OF THE INVENTION

[0002] 1. Field of the Invention

[0003] The present invention relates to precious metal materials. More specifically, the present invention is for making a textured flexible sheet of a precious metal.

[0004] 2. Description of the Related Art

[0005] Precious metal clays, also referred to as jewelry metal clays, are used in the manufacture of jewelry and for decoration of various objects, such as glass, porcelain, and ceramic objects. Essentially comprising a powdered precious metal, such as silver, gold, platinum, or the like, along with water and an organic binder, precious metal clays are moldable into shapes or figures that may then be sintered, whereby the water and binder are essentially removed, leaving a figure formed of a nearly pure precious metal such as 0.999 silver or 24 karat gold. Such precious metal clay compositions are described in U.S. Pat. No. 5,376,328, issued Dec. 27, 1994, and U.S. Pat. No. 5,328,775, issued Jul. 12, 1994, both to K. Hoshino, et al., and U.S. Pat. No. 5,702,501, issued Dec. 30, 1998 to Y. Osawa et al.

[0006] Precious metal clay, or PMC® (PMC is a registered trademark of Mitsubishi Materials Corporation of Tokyo, Japan), is commercially available from Rio Grande, 7500 Bluewater Road NW, Albuquerque, N. Mex. 87121 and other sources. Various uses and techniques for working with PMC are described in Welcome to PMC, Third Edition, copyright 2002, by The Bell Group.

[0007] For some applications, it is desirable to work with precious metal clay formed into thin sheets. Precious metal clay products are available commercially in sheet form. Additionally, the publication Welcome to PMC describes a method for rolling a portion of precious metal clay into a thin sheet.

[0008] It may be desired to form a functional or decorative surface texture on a sheet of precious metal clay. Generally, this may be accomplished by pressing an object having a surface texture onto the surface of a precious metal clay sheet, and applying pressure to imprint the precious metal clay sheet surface with the texture. This approach, however, is limited to use with objects that themselves are strong enough to withstand the pressure needed to imprint the surface texture onto the precious metal clay sheet without adversely affecting the quality of the texture imprinted. Additionally, a surface texture may be applied by hand tooling.

[0009] An improved method for forming a thin sheet, or veneer, of a precious metal material is therefore desired.

[0010] None of the above inventions and patents, taken either singly or in combination, is seen to describe the instant invention as claimed. Thus a textured flexible sheet of precious metal solving the aforementioned problems is desired.

SUMMARY OF THE INVENTION

[0011] The material and method for forming a textured flexible sheet of precious metal according to the present invention involves the use of a precious metal paste having a flowable consistency whereby the precious metal paste may be brushed onto a textured surface. The precious metal paste is applied to the textured surface, and allowed to dry to a flexible, leather-like consistency. Once dried, the precious metal material is removed from the substrate in the form of a thin sheet or veneer having a textured surface. The thin sheet or veneer may be sintered to produce a textured, thin sheet of a precious metal.

[0012] It is an object of the invention to provide improved elements and arrangements thereof for the purposes described which is inexpensive, dependable and fully effective in accomplishing its intended purposes.

[0013] These and other objects of the present invention will become readily apparent upon further review of the following specification and drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] FIG. 1 is a perspective view of a textured flexible sheet of precious metal according to the present invention.

[0015] FIG. 2 is a perspective view of a precious metal paste being applied to a substrate to form a textured flexible sheet of precious metal according to the present invention.

[0016] FIG. 3 is a perspective view of a textured flexible sheet of precious metal according to the present invention being removed from a substrate.

[0017] Similar reference characters denote corresponding features consistently throughout the attached drawings.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0018] The present invention is a material and method for making a textured flexible sheet of a precious metal. A textured flexible sheet of a precious metal, or precious metal veneer, designated generally as 10 in the figures, is shown in FIG. 1 having a textured side 12 and a flat side 14.

[0019] Referring to FIG. 2, the veneer 10 is formed by applying a precious metal paste 20 to the surface 32 of a substrate 30 using a brush 22. The substrate surface 32 has a texture that will give the veneer its textured surface 12. Once the paste has been allowed to dry, the veneer 10 is removed from the substrate 30, as seen in FIG. 3. The veneer 10 has a textured side 12 that matches the textured surface 32 of the substrate 30. It can be noted that the flat side 14 of the veneer 10 need not be completely flat, but may be textured from brush strokes or from an uneven surface of a substrate. The precious metal paste 20 is a material composition comprising a powdered precious metal, an organic binder, water, and glycerin, formulated to a flowable consistency similar to heavy whipping cream, paint, or the like.
In addition to forming a precious metal veneer 10 as described, a precious metal paste 20, formed from an electrically conductive precious metal, may be used to form or print electrical circuit trace interconnections on electrical circuit boards.

Precious metal clay materials, formulated from a powdered precious metal along with water and an organic binder to a clay or putty like consistency, are disclosed in U.S. Pat. Nos. 5,376,328, 5,328,775, and 5,702,501, incorporated herein by reference in their entirety. Because of their clay or putty like consistency, the precious metal clays are ill-suited to a brush application to a substrate. The precious metal paste 20 of the present invention comprises a powdered precious metal along with an organic binder similar to the precious metal clays, but with an additional quantity of water and the addition of glycerin. While a precious metal clay may be diluted to a flowable consistency by the addition of water alone, such a composition produces a veneer that is excessively brittle and difficult to handle, and difficult to remove from a substrate.

The precious metal paste 20 may be formed from commercially available precious metal clay products by softening the precious metal clay with a glycerin solution, and mixing the softened precious metal clay and the glycerin solution together to form a homogenous, flowable precious metal material composition. The glycerin solution is prepared by combining a quantity of deionized water with a quantity of commercial quality glycerin (a commercial glycerin preparation typically comprising about 95-100% glycerin and about 0-5% water). For a silver precious metal paste, the glycerin solution has a molar concentration of glycerin of between about 0.14M and about 2.0M. Table 1 shows the volume of glycerin to be added to eight (8) ounces (237 ml) of water to achieve various molar concentrations of glycerin within this range.

<table>
<thead>
<tr>
<th>GLYCERIN</th>
<th>WATER</th>
<th>MOLARITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>40 ml</td>
<td>237 ml</td>
<td>1.9787</td>
</tr>
<tr>
<td>35 ml</td>
<td>237 ml</td>
<td>1.7633</td>
</tr>
<tr>
<td>30 ml</td>
<td>237 ml</td>
<td>1.5397</td>
</tr>
<tr>
<td>25 ml</td>
<td>237 ml</td>
<td>1.3076</td>
</tr>
<tr>
<td>20 ml</td>
<td>237 ml</td>
<td>1.0665</td>
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<tr>
<td>15 ml</td>
<td>237 ml</td>
<td>0.8158</td>
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<tr>
<td>10 ml</td>
<td>237 ml</td>
<td>0.5549</td>
</tr>
<tr>
<td>5 ml</td>
<td>237 ml</td>
<td>0.2832</td>
</tr>
<tr>
<td>2.5 ml</td>
<td>237 ml</td>
<td>0.1431</td>
</tr>
</tbody>
</table>

An exemplary solution is prepared by combining 8 ounces (237 ml) of deionized water with 25 ml of the commercial quality glycerin to achieve a glycerin solution having a molarity of about 1.31M.

The effect of variation of the glycerin concentration was evaluated with respect to 1) the uniformity of consistency of the precious metal paste 20 produced; 2) the flexibility (both before and after firing) of a veneer 10 produced from the precious metal paste 20; 3) the resistance to tearing of an unfired veneer; and 4) weeping of glycerin from a veneer 10. The evaluation proceeded by forming a veneer 10 using a precious metal paste 20 of each glycerin concentration shown in Table 1. Each veneer 10 was allowed to dry, and was then cut to the same size as a control sample of commercially available sheet PMC. Each veneer 10 was then fired for two (2) hours at 1650 degrees F.

Each of the dilutions produced a smooth paste, with the exception of the 1.97M and 1.76M concentrations, where the precious metal paste 20 remained somewhat lumpy. The precious metal paste 20 of the 1.97M and 1.76M concentrations remained functional, and produced a good quality veneer 10. Weeping of the glycerin was observed in the 1.97M and 1.76M veneers (before firing), and was also observed (to a lesser degree) in the 1.53M veneer 10 at higher ambient temperatures. At concentrations of 1.53M, the veneers 10 exhibited a greater degree of shrinkage upon firing than at lower concentrations. At the lowest concentrations, the 0.28M and 0.14M veneers 10 exhibited lower flexibility and had a tendency to break easily on bending (in both fired and unfired states). The remaining concentrations (1.30M, 1.06M, 0.8M, 0.55M) produced a smooth paste and formed a flexible and tear resistant unfired veneer 10, and produced a flexible and durable fired veneer 10.

The precious metal clay is prepared by pinching the precious metal clay into small pieces, ideally about 3 mm in size. It can be recognized that, while the size is not critical, smaller pieces will yield a smoother paste but require more work, while larger pieces will take longer to soften in the glycerin solution and may yield a paste having unsatisfactory smoothness.

The precious metal clay pieces and an amount of the glycerin solution are placed together in a tightly closed container and left at room temperature for several hours or overnight, while the precious metal clay softens in the glycerin solution.

Silver precious metal clays are commercially available in different compositions, which require slight variations to the basic process of forming the paste. One composition (commercially available from RIO GRANDE as “Standard Silver PMC”) is an 80% pure silver clay containing 20% water and binder. Other compositions (commercially available from RIO GRANDE as “Silver PMC” and “Silver PMC3”) comprise a 90% pure silver clay containing 10% water and binder.

Preparation of the paste from Silver PMC or Silver PMC3 follows the same procedure. Twenty-eight (28) grams of the Silver PMC, or twenty-five (25) grams of the Silver PMC3, is used. The precious metal clay is formed into small pieces, and placed into a tightly covered container along with about 7.5 ml of the glycerin solution. The mixture is left to stand for several hours or overnight to hydrate the precious metal clay. The mixture is then stirred gently, and another 7.5 ml of the glycerin solution is added, and the mixture is again left to stand for several hours or overnight. At this point, the mixture is a smooth paste. An additional amount of glycerin solution is added, as needed, to obtain a viscosity similar to that of very soft butter.

To prepare the paste from standard silver PMC, 1 ounce of the precious metal clay is used. The precious metal clay, formed into small pieces, is placed into a tightly covered container along with about 15 ml of the glycerin solution, and left to stand for several hours or overnight to hydrate the precious metal clay. The mixture is then stirred gently, and another 15 ml of the glycerin solution is added, and the mixture again is left to stand for several hours or...
overnight. At this point, the mixture is a smooth paste. However, because the standard silver PMC has a higher binder content than the other forms, additional glycérin solution is added to obtain the proper viscosity. The final viscosity should be similar to that of very soft butter.

[0031] It can be understood that preparation of the paste is somewhat dependant on the temperature and humidity during preparation, requiring somewhat more or less glycérin solution. Additionally, the final viscosity of the paste may be varied for application to different types of substrate. If the paste is excessively thick, there is a greater chance that in use air bubbles will be trapped between the paste and the textured substrate surface. If the paste is excessively thin, the final veneer may be too thin and require additional coats of the paste. Thinner veneer sheets are more fragile, having a greater likelihood of damage or tearing during handling and application. Thicker sheets are more difficult to apply to rounded surfaces or sharp corners. It can be recognized that the thickness of the veneer may be varied depending on the desired application for the veneer.

[0032] The veneer retains the properties of the precious metal clay material from which it was made, including amount of shrinkage and range of firing temperatures. The veneer can be formed into, or applied to, an article of jewelry or artwork or another article, and sintered to become a piece of precious metal. Additionally, the veneer can be attached to conventional sheet form precious metal clay for increased thickness, or laminated back-to-back with another piece of veneer to produce a double-sided design element.

[0033] It is to be understood that the present invention is not limited to the embodiment described above, but encompasses any and all embodiments within the scope of the following claims.

We claim:
1. A precious metal material composition, comprising:
   a powdered precious metal;
   a binder;
   water; and
   glycérin;
   wherein said powdered precious metal, binder, water, and glycérin are combined to form a homogeneous flowable precious metal material.
2. The precious metal material composition according to claim 1, wherein said binder is an organic binder.
3. A method of forming a flowable precious metal material composition, comprising the steps of:
   softening a quantity of precious metal clay with a first quantity of glycérin solution; and
   mixing said softened precious metal clay and said glycérin solution together to form a homogeneous flowable precious metal material.
4. The method of claim 3, said softening step further comprises the step of forming said quantity of precious metal clay into a plurality of small pieces.
5. The method of claim 3, wherein said mixing step further comprises the step of adding a second quantity of glycérin solution to said softened precious metal clay.
6. The method of claim 3, wherein said glycérin solution is an aqueous solution having a molar concentration of glycérin of at least about 0.14M.
7. The method of claim 3, wherein said glycérin solution is an aqueous solution having a molar concentration of glycérin of between about 0.14M and about 2.0M.
8. The method of claim 3, wherein said glycérin solution is an aqueous solution having a molar concentration of glycérin of at least about 0.55M.
9. The method of claim 3, wherein said glycérin solution is an aqueous solution having a molar concentration of glycérin of between about 0.55M and about 2.0M.
10. The method of claim 3, wherein said glycérin solution is an aqueous solution having a molar concentration of glycérin of between about 0.55M and about 1.54M.
11. A method of forming a textured flexible sheet of precious metal, comprising the steps of:
   applying said flowable precious metal material to a textured surface of a substrate;
   allowing said flowable precious metal material to dry, thereby forming a veneer sheet; and
   removing said veneer sheet from said substrate.
12. The method of claim 11, further comprising the step of sintering said veneer sheet to form a thin sheet of a precious metal having a surface pattern formed by the textured surface of said substrate.
13. The method of claim 11, further comprising the step of combining a quantity of precious metal clay with a quantity of glycérin solution to form said flowable precious metal material;
14. The method of claim 13, wherein said glycérin solution is an aqueous solution having a molar concentration of glycérin of at least about 0.14M.
15. The method of claim 13, wherein said glycérin solution is an aqueous solution having a molar concentration of glycérin of between about 0.14M and about 2.0M.
16. The method of claim 13, wherein said glycérin solution is an aqueous solution having a molar concentration of glycérin of at least about 0.55M.
17. The method of claim 13, wherein said glycérin solution is an aqueous solution having a molar concentration of glycérin of between about 0.55M and about 2.0M.
18. The method of claim 13, wherein said glycérin solution is an aqueous solution having a molar concentration of glycérin of between about 0.55M and about 1.54M.

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