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REFRACTORY METAL COMPOSITION

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This invention relates to metal compositions and articles made therefrom.

An object is to improve metal powder compositions.

Another object of the invention is to improve powder metal bodies such as electric contacts, welding electrodes, welding dies, current carrying bearings or bushings, valve seats and the like.

Other objects of the invention will be apparent from the description and claims.

The present invention contemplates a metal composition made from refractory metal powders, particularly tungsten and molybdenum, which are individually coated with protective layers of a palladium-platinum group metal such as platinum, palladium or rhodium and are bonded together in a metal composition with a metal from the first group of the periodic table such as copper, silver or gold.

The refractory powder may vary in average diameter between 0.5 and 100 microns prior to coating and the coating of protective metal such as platinum, palladium or rhodium may vary in thickness from a fraction of a micron to several thousandths of an inch. Thus the relative percentages of refractory metal or compound and protective metals in the coated powders used for producing the metal composition of the present invention may fall within the following range of proportions:

	Percent
Refractory metal	99.99 to 10
Palladium-platinum group metal	0.01 to 90

The coated powders are interspersed and bonded with the second group metal and the resulting compositions may fall within the following range:

	Percent
Coated tungsten or molybdenum powders	5 to 99
Copper, silver or gold	Balance

This range may be divided into two general classes of materials, namely:

Predominantly refractory compositions containing—

	Percent
Coated refractory powders	50 to 99
Copper, silver or gold	Balance

Predominantly low melting point metal compositions containing—

	Percent
Coated refractory powders	5 to 49.9
Copper, silver or gold	Balance

Following are several examples of suitable metal compositions:

	Percent
(a) Molybedenum particles coated with rhodium	50
Silver	50
(b) Molybdenum particles coated with rhodium	60
Silver	40
(c) Tungsten particles coated with rhodium	65
Silver	35
(d) Tungsten particles coated with rhodium	50
Silver	50
(e) Tungsten coated with rhodium	80
Silver	20
(f) Molybdenum particles coated with platinum and/or palladium	50
Silver	50
(g) Molybdenum particles coated with platinum and/or palladium	60
Silver	40
(h) Tungsten particles coated with platinum and/or palladium	65
Silver	35
(i) Tungsten particles coated with platinum and/or palladium	50
Silver	50
(j) Tungsten coated with platinum and/or palladium	80
Silver	20
(v) Tungsten coated with platinum and/or palladium or rhodium	45
Gold	55
(w) Tungsten coated with platinum and/or palladium or rhodium	70
Copper	30
(x) Tungsten coated with platinum and/or palladium or rhodium	50
Copper	50

The protective coating of rhodium, platinum or palladium may be applied by any one of several methods such as electroplating, cathode sputtering, metal spraying, condensing evaporated metal on the particle surfaces, chemical deposition. They may also be coated by first coating the powders with a dispersible adhesive, then dusting the adhesive coated particles with the protective metals in powder form and subsequently heating the coated powders to disperse the adhesive and diffusing the protective metal onto the surfaces of the refractory powders. It is also possible to use a metal paste as a coating medium.

The metal compositions of the present invention may be made from the coated particles in several ways. The coated refractory particles, or a mixture of them, may be pressed to form a powder compact and the compact then sintered at a suitable temperature such as 1200° C. to form

a sinter-bonded metal body. This body is then impregnated with silver, copper or gold or any alloy of two or more of these, by placing the first group metal in contact with the sintered compact and heating the assembly in a reducing atmosphere to a temperature above the melting point of the lower melting metal so that it will flow into the pores of the sintered body and fill them.

The metal composition may also be produced by mixing the coated particles directly with powders of copper, silver or gold, or mixtures of these, pressing the mixed powders and then sintering the pressed mixture at a suitable temperature such as 950° C. to produce the finished composition. If desired, subsequent repressing or coining operations may be applied to further increase the density and improve the physical characteristics of the composition.

A third method of manufacture comprises a combination of the above two methods. According to this method, a portion of the copper, silver or gold in the form of a powder is mixed with the coated refractory powders and the mixture pressed in a suitable die. The pressed body is then sintered at a temperature to cause binding, such as 1250° C. Additional amounts of copper, silver or gold are then placed in contact with the sintered body and the assembly heated to a temperature above the lower melting point metal to cause impregnation.

During the sintering operation, according to any of the above methods, the protective layers of platinum, palladium or rhodium on the refractory metal particles diffuse into the refractory material to a greater or lesser extent, forming alloys or compositions at the surfaces of the particles. These surface layers are considerably more noble in character as far as oxidation is concerned than the refractory particles themselves. The degree of diffusion of the protective metal will depend upon the time and temperature of the sintering process. It is also contemplated that in some cases the coated powders may be pre-sintered in the loose state to accomplish diffusion before the powders are used in manufacturing the metal composition.

An advantage of the present composition and process resides in the affinity between the first group metals such as copper, silver and gold and the protective metals such as palladium, platinum or rhodium. Since the first group metals have a tendency to alloy with the protective layers they are readily drawn into any pores or spaces in the metal compact resulting in a denser and more nearly perfect and homogeneous metal structure. The alloying also produces a strong bond between the various metal phases present.

In some cases additions of small proportions of other ingredients may be made to the compositions. For instance, from a fraction of a per cent to 10% of carbon or boron may be added to the mixture. The carbon is preferably in the form of graphite.

Such elements as nickel, cobalt, iron, manganese or silicon may be added in proportions ranging from a fraction of 1% to 30%. These have the effect of increasing the hardness, wear resistance and tensile strength of the compositions.

One important use of the metal compositions of the present invention is in electric contacts. Electric contacts have heretofore been produced of compositions of refractory metals and compounds with silver and copper in various proportions. However, such compositions have developed relatively high contact resistances between the contacting surfaces and have exhibited a substantial temperature rise when subjected to continuous operation. The use of a protective metal coating from the palladium-platinum group on the refractory particles reduces the contact resistance considerably and produces a contact much less subject to overheating.

By using contacts formed of the compositions described on one or both sides of a contact pair, sticking and high contact resistance can be eliminated in most cases.

Refractory compositions of the present invention which are particularly suitable for cooperation with cadmium oxide contacts of the type described in Hensel Patent 2,145,690 are coated molybdenum particles with silver, and coated tungsten with silver.

While specific embodiments of the invention have been described, it is intended to cover the invention broadly within the spirit and scope of the appended claims.

What is claimed is:

1. A metal composition formed of particles of refractory metal selected from the group consisting of tungsten and molybdenum, and a coating thereon of metal selected from the group consisting of palladium, platinum and rhodium and metal selected from the first group of the Periodic Table consisting of copper, silver and gold interspersed with and bonded to said coated particles.

2. A metal composition formed of particles of refractory metal selected from the group consisting of tungsten and molybdenum, and a coating thereon of metal selected from the group consisting of palladium, platinum and rhodium and metal selected from the first group of the Periodic Table consisting of copper, silver and gold interspersed with and bonded to said coated particles, said coated particles being formed of 99.99% to 10% of said refractory metal and .01% to 90% of said coating metal, the coated particles forming 5 to 99% of said composition and said first group metal forming the balance.

3. An electric contact formed of a metal composition composed of particles of refractory metal selected from the group consisting of tungsten and molybdenum, and a coating on said particles of metal selected from the group consisting of palladium, platinum and rhodium and metal selected from the first group of the Periodic Table consisting of copper, silver and gold interspersed with and bonded to said coated particles.

4. An electric contact formed of a metal composition composed of particles of refractory metal selected from the group consisting of tungsten and molybdenum, and a coating on said particles of metal selected from the group consisting of palladium, platinum and rhodium and metal selected from the first group of the Periodic Table consisting of copper, silver and gold interspersed with and bonded to said coated particles, said coated particles being formed of 99.99% to 10% of said refractory metal and .01 to 90% of said coating metal, the coated particles forming 5 to 99% of said composition and said first group metal forming the balance.

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