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METAL COMPOSITION

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4 Claims. (Cl. 75—176)

This invention relates to metal compositions of refractory metals or refractory metal compositions with silver.

An object of the invention is to improve the properties of such compositions.

Another object is to produce a more uniform material.

A further object is to improve the process of manufacture.

A still further object is to produce an improved electrical contact.

Other objects of the invention will be apparent from the following description taken in connection with the appended claims.

The present invention comprises the combination of elements, methods of manufacture, and the product thereof brought out and exemplified in the disclosure hereinafter set forth, the scope of the invention being indicated in the appended claims.

While a preferred embodiment of the invention is described herein, it is contemplated that considerable variation may be made in the method of procedure and the combination of elements without departing from the spirit of the invention.

Heretofore metal compositions of molybdenum, tungsten, molybdenum carbide and tungsten carbide have been produced by pressing the powders of the refractory material either alone or mixed with silver powder, sintering the pressed body thus formed and subsequently alloying by heating the body in contact with molten silver. In some cases it has been necessary to repress the sintered body before alloying to bring about more complete absorption of the silver.

Considerable difficulty has been experienced with the above process due to incomplete absorption of the silver and resulting porosity or non-uniformity of the product. In some cases it has been necessary to use higher proportions of silver powder to obtain a satisfactory product and to use extremely high alloying temperatures.

We have discovered that the above disadvantages can be eliminated and an improved product obtained by the addition of a small proportion of copper powder to the refractory powder or the mixture of refractory powder and silver powder before pressing. The small amount of copper appears to greatly increase the absorption of silver into the sintered body producing a denser material of better strength and hardness and higher electrical conductivity than the prior materials. The addition of copper also eliminates the need for repressing the sintered material before alloying.

The preferred manufacturing procedure for a molybdenum-silver-copper composition according to the present invention is as follows:

92% molybdenum, 7% silver and 1% copper powders are mixed and ball milled for two or three hours. It is preferable to start with fine powders such as 300 mesh or finer. After ball milling the mixed powders are sifted through a 90 mesh sieve.

The powders are then pressed into suitable shapes, such as contact discs or plates, or other desired forms. The pressure should be sufficient to press the material to a density of about 6.5 grams per c. c. A pressure of 5 to 7 tons per square inch will ordinarily be sufficient.

The pressed powders are then sintered at 1100° to 1250° or 1300° C. for one half hour.

The sintered material, without repressing, is then alloyed with additional silver at 1100° to 1300° C. for 10 to 30 minutes. This may be accomplished, for example, by placing the sintered material in a graphite boat and placing about 70% silver shot (by weight of the pressed piece) against the sintered material and heating to the alloying temperature in an appropriate atmosphere.

The resulting material has about the following composition:

	Percent
Molybdenum	59.5
Silver	40
Copper	.5

The hardness obtained with this composition is 80 to 90 Rockwell B, the density about 10.25 to 10.35 grams per c. c., the cross breaking strength 150,000 to 160,000 pounds per square inch and electrical conductivity 45% to 55% of that of pure copper.

This represents a decided improvement over the best prior procedure for making a 60% molybdenum-40% silver composition involving a repressing after sintering with pressures of 35 to 40 tons per square inch. The prior procedure resulted in a hardness of 70 to 80 Rockwell B, a density of 10 to 10.25 grams per c. c., a cross breaking strength of 100,000 to 115,000 pounds per square inch and an electrical conductivity of 40% to 45% of that of copper.

Similar improvements are obtained when tungsten, tungsten carbide and molybdenum carbide are used in place of molybdenum. The proportions of the ingredients may be varied con-

siderably and still obtain the advantages of the present invention. The suitable materials for most purposes, and particularly for electric contacting elements, will generally fall within about the following range of proportions:

	Percent
Refractory material	30 to 90
Silver	10 to 70
Copper	.1 to 2.5

Generally the lower proportions of copper are preferred.

The preferred range for the molybdenum base material for electric contacting elements is:

	Percent
Molybdenum	58 to 62
Silver	38 to 42
Copper	.3 to 1

Apparently the copper acts as a wetting agent for the refractory material during the sintering and the alloying of the silver. This probably produces a stronger bond between the refractory particles and the silver in the finished composition.

Copper has the added advantage when used for this purpose in that it has high electrical conductivity and forms solid solutions with silver.

The present invention makes possible the satisfactory manufacture of larger pieces than heretofore.

Less silver is required to produce a uniformly impregnated material.

Higher electrical conductivity and greater strength, hardness and density are obtained.

While the present invention, as to its objects and advantages, has been described herein as carried out in specific embodiments thereof, it is not desired to be limited thereby but it is intended to cover the invention broadly within the spirit and scope of the appended claims.

What is claimed is:

1. The method of making a refractory metal composition composed of 30 to 90% of refractory material selected from the group consisting of molybdenum and tungsten and their carbides, 10 to 70% of silver and .1 to 2.5% of copper which comprises mixing together the powdered constituents while retaining aside at least a part of the silver, pressing the mixed powders into a compact mass, sintering the mass and then heating the sintered mass in contact with the silver in molten condition to impregnate the mass therewith.

2. The method of making a refractory metal composition composed of 30 to 90% of refractory material selected from the group consisting of molybdenum and molybdenum carbide, 10 to 70% of silver and .1 to 2.5% of copper which comprises mixing together the powdered refractory material and copper, pressing the mixed powders into a compact mass, sintering the mass and then heating the sintered mass in contact with molten silver to impregnate the mass therewith.

3. The method of making a refractory metal composition composed of about 58 to 62% molybdenum, 38 to 42% silver and .3 to 1% copper which comprises mixing together the powdered molybdenum, copper and a minor part of the silver, pressing the mixture into a compact mass, sintering the mass and then heating the sintered mass in contact with the remaining silver in molten condition to impregnate the mass with said silver.

4. The method of manufacturing a refractory metal composition for electric contact elements and the like composed essentially of a high melting constituent and silver, said high melting constituent being a refractory material selected from the group consisting of molybdenum and tungsten and their carbides and comprising 30 to 90% of said composition, the balance of said composition being essentially silver, which comprises mixing with the composition prior to pressing a small amount of copper not exceeding 2.5% to facilitate wetting of the refractory material by the silver and producing a stronger bond between the refractory material and the silver, and thereafter pressing the composition into a compact mass.

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