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PALLADIUM BASE ALLOY AND METHOD OF PRODUCING SAME

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8 Claims. (Cl. 75—172)

This invention relates to novel alloys of palladium and gallium, and to a method for their production. More particularly, the invention concerns palladium base alloys containing from about ½% to about 15% by weight of gallium.

Alloys of metals of the platinum group with baser metals have been employed commercially for many years in applications such as electrical and switch contacts, electrical conductors, resistance wire, and the like, where high electrical and thermal conductivity, resistance to heat and corrosion, ductility, and tensile strength are of importance. Thus, such metals as platinum, palladium, rhodium and iridium have been alloyed with silver, nickel, copper and zinc. A known alloy of platinum containing about 8% tungsten is extensively used for the production of electronic components, for example as a wire contact member in diodes. This alloy has disadvantages which include a Rockwell hardness of only about 22, and a fairly low resistance to flexing or bending, frequently breaking when first sharply bent. Alloys of palladium and zinc have been proposed for telephone circuitry, but the preparation of these alloys offers some difficulty in that it involves diffusion of the zinc into the palladium at high temperatures.

In accordance with the present invention, new and useful alloys have been prepared from palladium and gallium which possess outstanding properties of resilience, hardness and resistance to fatigue. These novel alloys comprise palladium containing from about ½% to about 15% by weight of gallium.

The new alloys of the invention are useful as electrical contact elements, for example with silicon diodes. An alloy containing about ½% to 2½% and preferably about 1% to 2% gallium has proved especially useful for diodes as a substitute for gold bonded diodes. They can readily be manufactured in any form, shape or thickness, as for example, in the form of sheets or wires of any desired gauge. Their resilience renders them suitable for use for small springs for watches and scientific instruments. The resistivity of the alloys makes them especially valuable in potentiometers.

The alloys of palladium and gallium are prepared simply and directly by heating together palladium metal in the form of strip or wire and the required quantity of gallium metal at a temperature slightly above the melting point of the palladium until the molten mass has become homogeneous. The mass is allowed to cool and can be fabricated into any desired shape. The novel alloys of the invention can be heat treated.

The starting materials are palladium, preferably of pure grade (99.9%), having a melting point about 1554° C., and a specific gravity of 12.0, and gallium metal. The gallium is a silvery-white metal, having a melting point of 29.7° C., and hence generally liquid at ordinary temperatures, and having a boiling point of 1983° C. Its specific gravity is 5.9 (solid).

The palladium-gallium alloys of the invention have a silvery-white appearance, and a melting point slightly below that of palladium. The specific gravity is about 11.15.

The preparation and properties of the novel palladium-gallium alloys of the invention as a class are illustrated by one preferred embodiment of the invention, which is a ribbon alloy of palladium containing 8% gallium by weight, and are set forth in the following example.

Example

92 grams of palladium wire were heated together with 8 grams gallium in a crucible placed in an electric furnace until the palladium had completely melted, the temperature then being 2831° F., and the mass had become homogeneous. The molten alloy was allowed to cool, removed from the crucible, and formed into ribbon. If desired, the alloying can be conducted under an atmosphere of an inert gas, such as nitrogen.

The resulting alloy was silvery-white in appearance, and had a specific gravity of 11.15. It possessed a tensile strength of about 200,000 pounds per square inch, and a hardness on the Rockwell "C" scale of 36.

The alloy had an electrical resistance of 250 ohms per circular mil foot. It is very ductile and can readily be rolled into wire or flat ribbon.

The electrical resistance properties of the alloys of the invention have been found to be a function of the amount of gallium present, higher percentages of gallium imparting higher resistance and vice versa. When rolled into ribbon of widths ranging from 0.015 to 0.0700 inch and thickness ranging from 0.002 to 0.0095 inch, they provide an electrical contact member which is especially effective and economical in connection with diodes.

The following is data on the various percentages of gallium alloyed with palladium.

	Resistance, ohms/c.m.f.	Hardness
Pure Palladium	70	1—Rockwell "B."
½% Gallium	82	22—Rockwell "B."
1% Gallium	95	56—Rockwell "B."
2% Gallium	120	4—Rockwell "C."
8% Gallium	250	35—Rockwell "C."
15% Gallium	400	45—Rockwell "C."

This patent is a continuation-in-part of application Serial No. 162,593, filed December 27, 1962, now abandoned.

I claim:

1. A palladium base alloy consisting essentially of from about ½% to about 15% by weight of gallium.

2. A palladium base alloy consisting essentially of from about ½% to about 15% by weight of gallium, the remainder of the alloy being palladium.

3. A palladium base alloy consisting essentially of from about ½% to about 2½% by weight of gallium, the remainder of the alloy being palladium.

4. A palladium base alloy consisting essentially of 92% palladium and 8% gallium by weight.

5. A palladium base alloy consisting essentially of 98% to 99% palladium and 2% to 1% gallium by weight.

6. An electrical contact member formed of a palladium base alloy consisting essentially of from about ½% to about 15% by weight of gallium.

7. An electrical contact member formed of a palladium base alloy consisting essentially of 92% palladium and 8% gallium by weight.

8. An electrical contact member formed of a palladium base alloy consisting essentially of 98% to 99% palladium and 2% to 1% gallium by weight.

References Cited in the file of this patent

Hansen: Constitution of Binary Alloys, 1958, McGraw-Hill Book Company, Inc., New York, page 752.