

1

3,099,539

GOLD SILICON ALLOY

Hamburg Tang, New York, N.Y., assignor to Alloys Unlimited Inc., Long Island City, N.Y.

No Drawing. Filed Jan. 11, 1962, Ser. No. 165,679

5 Claims. (Cl. 29—183.5)

This invention relates to a new and improved gold silicon alloy and means and methods of making foil from said alloy.

More particularly the invention relates to means and methods of making gold silicon foil of a thickness of .001-.002 inch.

Many unsuccessful attempts to achieve this object were made as will be discussed before arriving at the present process which generally comprises the steps of casting an ingot approximately $\frac{1}{8}$ inch by 1 inch by 6 inches of the alloy $5.6 \pm 1\%$ silicon and the remainder substantially of gold, and hot rolling the ingot at a temperature of 200°C . down to a thickness of .001-.002 inch thick.

Accordingly, a principal object of the invention is to provide new and improved gold silicon alloy.

Another object of the invention is to provide new and improved gold silicon foil of a thickness of .001-.002 inch.

Another object of the invention is to provide new and improved process for making gold silicon foil.

Another object of the invention is to provide a new and improved process for making gold silicon foil comprising the steps of casting an ingot of the alloy $5.6\% \pm 1\%$ silicon and remainder substantially of gold and hot rolling the ingot at a temperature of 200°C . down to a thickness of .001-.002" thick.

These and other objects of the invention will be apparent from the following specification.

The following were unsuccessful attempts to solve the problem:

Example 1

Finally ground Si and Au powders were mixed to the stoichiometric eutectic composition (94Au/6Si by weight), then compacted hydraulically at room temperature in a 1" diameter mold to .100" thick at 15M pounds pressure. This disc was then sintered in a reducing atmosphere for approximately six hours at a temperature of 500°C . This was above the eutectic temperature of 370°C . in an attempt to promote diffusion and alloy homogenization. The sintered discs were then normally rolled with a very light reduction pass (approximately 1% reduction). After a large number of passes in the reduction to .050 thickness, the ingot cracked to the extent that further processing became impossible.

Example 2

The eutectic alloy was melted, cast and ground to powder by conventional techniques. The powder was then processed as in the previously described experimentation, except that the sintering temperature was slightly below 370°C ., with a similar measure of success.

Example 3

The eutectic alloy was cast into an ingot approximately $\frac{1}{8}$ " thick, 1" wide, 6" long. By conventional rolling techniques, the ingot was reduced approximately 1% per

2

pass and after .010" of reduction, the ingot cracked badly. Several attempts to overcome this problem by employing annealing techniques proved unsuccessful.

Example 4

Experimentation on continuously cast foil was attempted. This technique was somewhat of a modification of hot extruding. A special miniature casting mold was built, but the cooling ingredient could not be controlled satisfactorily. The resulting foil was very discontinuous with variations in thickness and surface texture. Even by applying pressure to the molten alloy, these many problems could not be overcome.

Example 5

Further experimentation continued along the lines of hot rolling ingots. This turned out to be our successfully developed production process. Alloy ingots were cast $\frac{1}{8}$ " thick, 1" wide, 6" long and hot rolled at a temperature of approximately 150°C . The ingot was successfully reduced to .030" thickness. At this point, however, further reduction resulted in cracking the foil too much. By employing higher hot rolling temperatures (approximately 200°C .), the ingot could be reduced further down to .007". Further reduction, even with more elevated working temperatures, proved difficult and erratic.

At this point, production experience indicated that some cast lots were easily rolled down to .001"-.002" thick. Further analysis indicated that these lots were slightly richer in gold than the composition of the eutectic indicated in "Constitution of Binary Alloys" by Hansen. On page 232 of this text, the eutectic was indicated at approximately 6 wt. percent Si. An investigation was undertaken to study the composition range that could most easily be fabricated and yielded the most consistent results not only in terms of processing, but also for melting point reproduction. The composition of the alloys investigated ranged from 5.5 to 6.5 wt. percent Si. Results of these experiments indicated $5.6 \pm 1\%$ Si to produce the most reproducible ingots for hot rolling, homogenization and melting point control. This composition proved to be closer to the eutectic than 6.0%.

Example 6

The final process which produced successful uniform thickness foil in the range .001-.002" comprised the steps of casting an ingot of the alloy $5.6\% \pm 1\%$ weight of silicon and the remainder gold. The size of the ingot is preferably about $\frac{1}{8}$ " thick and is preferably about 1" wide and 6" long for convenient rolling. The ingot is then hot rolled at a temperature of approximately 200°C ., the rolling being repeated until the thickness is uniformly reduced to the thickness desired. Successful foil has been produced down to .001" thick.

It is noted that the eutectic point was found to be different from that found in Hansen mentioned above. However, Hansen states that the eutectic point indicated was uncertain.

Many modifications may be made by those who desire to practice the invention without departing from the scope thereof which is defined by the following claims:

I claim:

1. The foil comprising substantially 5.6% by weight of silicon and remainder of gold.

3

2. The foil comprising substantially 5.6% by weight of silicon and remainder of gold, said foil being .001-.002 inch thick.

3. The foil comprising substantially $5.6\% \pm 1\%$ by weight of silicon and the remainder substantially of gold. 5

4. The process of making gold silicon foil comprising the steps of:

casting ingots of the alloy 5.6% by weight silicon and and remainder of gold, and

hot rolling said ingots at a temperature of approximately 200° C. down to a thickness of .001-.002 inch. 10

5. The process of making gold silicon foil comprising the steps of:

casting ingots of the alloy $5.6\% \pm 1\%$ by weight silicon and remainder gold, 15

4

said ingots being approximately $\frac{1}{8}$ inch thick, hot rolling said ingots at approximately 150° C. to a thickness of .030 inch thick and further hot rolling at 200° C. to a thickness of substantially .002 inch thick.

References Cited in the file of this patent

UNITED STATES PATENTS

2,747,971	Hein	May 29, 1956
2,877,147	Thurmond	Mar. 10, 1959

OTHER REFERENCES

Hansen: "Constitution of Binary Alloys," 2nd ed., McGraw-Hill Book Company, Inc., page 232, New York, 1958.