United States Patent Office 3,567,429 Patented Mar. 2, 1971

3,567,429

PROCESS FOR PREPARING A STRONTIUM AND/OR BARIUM ALLOY

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No Drawing. Filed Sept. 9, 1968, Ser. No. 758,605
Claims priority, application Germany, Sept. 21, 1967, P 16 08 245.4
Int. Cl. C22d 7/06
U.S. Cl. 75—10 2 Claims

ABSTRACT OF THE DISCLOSURE

Strontium and/or barium are charged into a silicon melt having a temperature of from 650 to 1700° C. and containing from 0.5% to 70% of magnesium, calcium, or aluminum, and a flux. The melt is stirred vigorously. Substantially all of the strontium and/or barium is alloyed. The alloy is then used to refine aluminum.

This invention relates to a process for producing alloys containing strontium and/or barium which are used for refining aluminum alloys.

Small amounts of alkaline earth metals have been introduced into aluminum alloys containing silicon in order to refine the alloys as disclosed in German Pat. 459,408. Calcium has also been introduced in the form of metallic calcium or calcium pre-alloys or aluminum-silicon alloys in amounts of from 0.005 to 0.5% in order to refine the alloys as disclosed in DDR Pat. 19,324. As disclosed in DAS 1,222,518, strontium compounds have been used in iron silicon compounds and alloyed at a temperature of about 1500° C. and in which the iron silicon contains only small amounts of aluminum and calcium. The silicon in the iron silicon is supposed to reduce the strontium compounds so that the strontium is absorbed in the melt.

However, technically and in practice, these methods are not very economic, since less than 10% of the metallic strontium is alloyed. Consequently, the methods of preparing strontium containing iron silicon could not be used to produce an alloy for refining aluminum alloys since the strontium containing alloy is in an insufficient amount to place the strontium and/or barium into the silicon alloy melt.

The object of this invention is to produce a simple and economic method for producing strontium and/or barium containing silicon alloys which contain such high amounts of strontium and/or barium as to be usable as refining alloys for aluminum silicon alloys.

In general, this object is obtained by introducing an alkaline earth metal of strontium and/or barium into a silicon alloy at a high temperature while stirring the melt vigorously and adding a flux. More specifically, the silicon melt containing 0.5% and at most 70% of magnesium and/or calcium and/or aluminum is alloyed with a strontium and/or barium compound at a temperature of from 650 to 1700° C. and preferably from 1000 to 1450° C.

Oxides, carbonates or sulfates of strontium and/or barium are especially suitable compounds for this invention. These compounds are introduced into the silicon melt in a well dried condition in order to prevent explosions due to the moisture in the compounds. Alkali-halogenides, alkaline earth halogenides, borax, aluminum chloride, carbon or substances having a high carbon content such as powdered coke, carbon dust or carbon tar can be used as the added substances for use as fluxes for the strontium and/or barium compounds. The carbonates

produce a most favorable and smooth melting in of the strontium and/or barium compounds.

Suitable starting materials for producing the strontium and/or barium silicon alloys are binary silicon alloys containing 0.5 to 50% magnesium, preferably 5 to 30% magnesium, and the remainder being silicon with the usual impurities, such as iron or magnesium. The magnesium is the reactive alloying element which reduces the strontium and/or barium compounds.

Also suitable as a starting substance are binary silicon alloys containing 0.5 to 50% calcium, preferably 5 to 30% calcium, with the remainder being silicon with the usual impurities. The calcium is used to reduce the strontium and/or barium compounds in the method of this invention.

Also usable are binary silicon alloys containing 0.5 to 50% aluminum, preferably 5 to 40% aluminum, with the remainder being silicon with the usual impurities. The aluminum is used as the reducing element for the strontium and/or barium compounds.

Moreover, even ternary and quaternary silicon alloys are usable provided they contain magnesium and/or calcium and/or aluminum. Such alloys are composed of 0.5 to 50% magnesium, preferably 5 to 30% magnesium and/or 0.5 to 50% calcium, preferably 5 to 30% calcium, and/or 0.5 to 50% aluminum, preferably 5 to 40% aluminum, however not more than 70% if all three are present, the remainder being silicon with the usual impurities, such as iron and magnesium.

In order to assure a good mixing of the strontium and/or barium compound with the silicon alloy melt and to produce new contact surfaces in the melt, it is essential that the melt be vigorously stirred. This can be accomplished, for example, by using mechanical stirring mechanisms or by stirring caused by an upward flow of inert gas bubbles through the melt, which bubbles act like beads. An electric induction furnace is especially appropriate for the method of this invention. In the induction furnace using a power supply frequency, it is possible to electromagnetically stir the melt in the crucible and achieve a satisfactory mixing of the components while constantly renewing the surface of the bath.

Basic as well as acid tamping clays have been satisfactorily used for lining the crucible. However, it is of especial advantage when the alloy components are melted in a crucible lined with carbon or a carbonaceous material or if they are melted in a carbon or graphite crucible.

The alloy is accomplished at a melt temperature of from 650 to 1700° C. when the melt is vigorously stirred, as when using a power supply frequency furnace, it is of advantage to have the melt at a temperature of from 1000 to 1450° C.

The compound containing strontium and/or barium and a flux, if needed, is put in portions on the surface of the melt, the furnace heat turned off, and after the compound has sunk into the melt, the heat is turned on and the mixture in the melt is stirred. The compound can be satisfactorily added to the melt by being permitted to trickle continuously onto the surface of the melt. The result is that the compounds are well received in the melt. In the method of this invention, a yield of up to 100% of the alkaline earth metals being alloyed is achieved. This, of course, relates to the compounds of such metals which contain the strontium and/or barium.

The method of this invention has special advantages. It makes possible the production of starting alloys which can be used for the refinement of aluminum alloys and which have a high strontium and/or barium content and which can be produced with a high yield. It is also possible in this invention for the production of the starting alloys

to use conventional cheap barium and/or strontium compounds available on the open market and thus economical. It is also possible to use a silicon carrier which already contains calcium or aluminum, such as calcium silicide, which is cheaply obtained. Again, no large apparatus expense is involved in this invention as compared to the production of refining alloys from metallic components. Further, the direct reduction process for producing the refining alloys is simpler than a method using an alloying process since in the latter case a loss by burning and waste of the strontium and/or barium occurs.

The following examples specifically disclose the method of this invention:

EXAMPLE 1

3 kg. of a composition composed of 20% magnesium, remainder silicon with the usual impurities such as iron, aluminum and calcium, were placed in a graphite crucible which was inserted in a power supply frequency furnace. This charge was heated to 1300° C. and melted. The furnace heat was then shut off and 250 g. of strontium carbonate introduced into the the melt. After the strontium carbonate sintered and melted, the furnace heat was turned back on and the melt was stirred. Then the furnace heat was again turned off and an additional 250 g. of strontium carbonate was sprinkled on the surface of the melt and, in turn, melted. The furnace heat was then turned on again and this additional strontium carbonate stirred into the melt. Then the furnace heat was turned off and the slag or dross in the melt settled to the bottom of the crucible and the melt floating above the slag was poured off. The analysis of the poured off material showed a silicon alloy containing 16.2% magnesium, 8.5% strontium and the remainder silicon. Since the introduced stronium carbonate contained 54% strontium, the result was that 100% of the strontium carbonate reacted with the magnesium so that the strontium was completely absorbed into the alloy.

EXAMPLE 2

3 kg. of a calcium silicon composition containing 10% calcium with the usual impurities was placed in a graphite crucible which was inserted in a power supply frequency induction furnace and was heated in about one-half hour to 1300° C. The furnace heat was turned off and 250 g. of dry strontium carbonate introduced into the melt. The strontium carbonate melted within 20 minutes and was stirred into the melt after the furnace heat was turned on again. Additional strontium carbonate was added three more times in the same procedure so that a total of 1 kg. of strontium carbonate was introduced into the melt. The melt yielded an alloy containing 16.6% Sr, 0.9% ca, with the remainder Si. The strontium yield was 100% with regard to the strontium carbonate that was initially introduced.

EXAMPLE 3

30 kg. of a silicon alloy containing 10% magnesium, remainder silicon with the usual impurities, was placed in a power supply frequency furnace lined with a tamping clay containing carbon and melted at a temperature of 1400° C. The furnace heat was turned off and 5.5 kg. of a mixture composed of 5 kg. of dry strontium carbonate and 0.5 kg. of a powdered electrode carbon was introduced into the melt. The furnace heat was turned off and after waiting 10 minutes the charged mixture was stirred into the melt by electromagnetic stirring. After the introduced mixture was completely dissolved, the silicon alloy produced contained 7.5% strontium and 6.9% magnesium, remainder silicon. This corresponds to a yield of 89% with regard to the strontium content in the strontium carbonate.

EXAMPLE 4

3 kg. of a silicon alloy composed of 20% magnesium, remainder silicon with the usual impurities, was placed in a graphite crucible that was inserted in a power supply frequency furnace and melted at a temperature of 1400° C. The furnace heat was turned off and 500 g. of barium carbonate was sprinkled on the surface of the melt. After waiting 15 minutes, and after the barium carbonate had sintered and melted in the melt, the furnace heat was again turned on and the melt was stirred. The alloy obtained was composed of 9.3% barium, 16.4% magnesium, remainder silicon. This corresponded to a yield of 87% of barium with regard to the barium carbonate.

Having now described the means by which the objects of this invention are obtained, we claim:

We claim:

1. A method for preparing an alloy containing strontium and/or barium for the refinement of aluminum silicon alloys comprising forming a silicon melt in a carbonaceous material lined crucible in a power supply frequency induction furnace at a temperature of about 650 to 1700° C., preferably from 1000 to 1450° C., and containing from 0.5 to 70% of a metal selected from the group consisting of magnesium, calcium, or aluminum, adding to said melt an alkaline earth selected from the group consisting of the oxides, carbonates, or sulfates of strontium or barium and a carbonaceous flux, and vigorously stirring said melt to form the alloy.

2. A method as in claim 1, said metal in said silicon melt comprising 0.5 to 50%, preferably 5 to 30% magnesium, 0.5 to 50%, preferably 5 to 30% calcium, and 0.5 to 50%, preferably 5 to 40% aluminum.

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U.S. Cl. X.R.

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