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ALUMINUM MASTER ALLOYS

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9 Claims

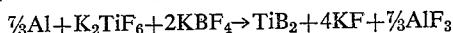
ABSTRACT OF THE DISCLOSURE

Aluminum master alloys, containing finely divided transition metal boride dispersed throughout the aluminum, are prepared by forming a molten mixture of aluminum, a transition metal boride and a flux and cooling the molten mixture. The flux is an inorganic fluoride which assists in the wetting of the boride with the aluminum.

This invention relates to aluminum alloys containing a finely divided metal boride, and to the preparation of said alloys useful in the production of fine grain aluminum.

It is known that the presence of up to about 100 p.p.m. by weight of a metallic boride having a hexagonal structure, such as the transition metal borides, confers a fine grain structure on cast aluminum, which is of great importance when the aluminum is to be rolled into sheet or foil. In general, these borides should be used in the form of fine powders as their effectiveness depends upon the number of particles present; and moreover, large particles are abrasive and lead to inhomogeneity.

In practice, it is virtually impossible to add the requisite very small quantity of a finely divided boride to molten aluminum without the former being oxidized during the addition, and rendered ineffective as a grain refining agent. To overcome this difficulty it is customary to prepare a master alloy of aluminum containing boron, and titanium or another metal which will form a hexagonal boride, said alloy being in the form of the elements, or the boride, or a mixture of the two, and to use this alloy as a source of boride in the preparation of fine grain aluminum. Such master alloys contain for instance, from 0.5 to about 10% or more, by weight of boride. Hitherto, these master alloys have been made by the reaction of aluminum with a mixture of complex fluorides of the metal from which the boride is derived and of boron. An example of one such process is:



However, this process is expensive and relatively inefficient, and the product contains an undesirably high proportion of coarse particles.

We have now found that finely divided borides, such as of particle size less than about 5 microns, can be evenly dispersed in aluminum to form a master alloy by means of the use of a suitable flux which causes the boride to be thoroughly wetted by the aluminum. The use of the flux also serves to prevent the oxidation of the finely divided particles of boride.

Accordingly, the present invention comprises in one aspect a process for the preparation of a master aluminum alloy which comprises forming a molten mixture of aluminum, a finely divided metal boride, and a flux, said flux comprising a fluoride which assists in the wetting of the boride with the aluminum. Metal borides which can be used are the transition metal borides, such as titanium diboride, chromium diboride, zirconium diboride and vanadium diboride, and preferably those capable of existing in a hexagonal form.

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The fluxes which have been found to be particularly effective are complex halides, especially the inorganic fluorides such as K_2ZrF_6 , K_2TiF_6 , Na_3AlF_6 , potassium fluoride, and mixtures of potassium fluoride with potassium chloride or with potassium iodide or with a mixture of the two. In general, any complex halide or mixture of halides containing a fluoride as one component which causes the boride being used to become wetted by aluminum can be used. The amount of flux used is not narrowly critical, varying from as little as about one hundredth of the weight of boride to an amount equal to the weight of the boride. Preferably, at least about one tenth of the weight of the boride is used.

The aluminum master alloy can be made, for instance, by mixing the finely divided boride with the flux, and blending the mixture with molten aluminum. Alternatively, the mixture of the flux and boride can be heated with solid aluminum until the metal melts, and then the mixture is stirred. On cooling, a solid master alloy containing the finely divided boride dispersed throughout is obtained. This in turn can be added to larger quantities of molten aluminum in order to obtain a final product containing, for example, up to about 100 p.p.m. of the boride in a form which results in the final cast aluminum product to be fine grained.

The resultant alloy contains boride of a known and controlled particle size evenly dispersed throughout the aluminum. Such alloys are far superior to previous master alloys which contained particles of widely varying sizes and of uncontrolled distribution.

The invention is illustrated by the following examples, but it is to be understood that my invention is not restricted to the specific examples given.

EXAMPLE I

Ten grams of titanium diboride having a mean particle size of 2.5 microns was mixed with six grams of potassium hexafluorozirconate and placed in an alumina crucible. Ninety grams of aluminum in a single piece was placed on top of the mixture and the crucible was heated until the aluminum and the flux had melted. The mixture was stirred and allowed to cool. The solid product, obtained after being freed from excess flux by washing with water, contained 9.5% of finely divided titanium diboride evenly dispersed throughout the aluminum.

EXAMPLE II

The procedure of Example I was repeated using 7.5 grams of titanium diboride 2.5 grams of sodium aluminum fluoride (cryolite) and 100 grams of aluminum. A master alloy containing at least 95% of the titanium diboride evenly dispersed in aluminum was obtained.

EXAMPLE III

The procedure of Example I was repeated using 7.5 grams of chromium diboride, 2.5 grams of a 1:1, by weight, mixture of potassium fluoride and potassium iodide, and 100 grams of aluminum. A master alloy containing at least 95% of the chromium diboride evenly dispersed in aluminum was obtained.

EXAMPLE IV

The procedure of Example I was repeated using 7.5 grams of zirconium diboride, 2.5 grams of sodium aluminum fluoride and 100 grams of aluminum. The resultant master alloy contained at least 95% of the zirconium diboride evenly dispersed in the aluminum.

Similar results were obtained using 2.5 grams of potassium fluoride as flux instead of the sodium aluminum fluoride.

What is claimed is:

1. The process for the preparation of a master aluminum alloy which comprises forming a molten mixture of

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aluminum, a finely divided transition metal boride and a flux, and cooling said molten mixture to form a master aluminum alloy having said transition metal boride dispersed throughout said aluminum, said flux comprising an inorganic fluoride which assists in the wetting of said boride with said aluminum.

2. The process according to claim 1 wherein said finely divided boride and said flux are mixed and then blended with molten aluminum.

3. The process according to claim 1 wherein said aluminum, said boride and said flux are heated until the metal melts and the mixture is stirred to disperse the boride throughout the aluminum.

4. The process according to claim 1 wherein said boride has a hexagonal structure.

5. The process according to claim 1 wherein said boride is titanium diboride.

6. The process according to claim 1 wherein said flux is potassium hexafluorozirconate.

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7. The process according to claim 1 wherein said flux is sodium aluminum fluoride.

8. The process according to claim 1 wherein the amount of flux is from about one tenth to an equivalent amount, by weight, of said boride.

9. The process according to claim 1 in which said boride is chromium diboride.

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