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Chung-Hsuan Chen

696,881 MACHINABLE DISSOLVED METAL OXIDE SUPERCONDUCTORS

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INVENTOR: Chung-Hsuan Chen
1812 Plumb Branch Road
Knoxville, Tennessee 37932
Knox County
Citizen of the United States

DISCLAIMER

MACHINABLE DISSOLVED METAL OXIDE SUPERCONDUCTORS

This invention relates to superconductors and particularly to machinable dissolved metal oxide superconductors, and was developed pursuant to a contract with the United States Department of Energy, contract number DE-AC05-84OR21400 and funded by Oak Ridge National Laboratory seed money.

BACKGROUND OF THE INVENTION

In superconductors there is a critical temperature (T_c) at which resistance to the passage of electricity disappears. Conventional superconducting metals, alloys and compounds have critical temperatures ranging from just above absolute zero to about 15 to 20°K. Practical applications for such superconductors are limited because they are operative only at extremely low temperatures.

A new class of superconductors, designated as high temperature superconductors, has recently been discovered and is being extensively investigated. Of these, high-T_c metal oxide superconductors have aroused unprecedented attention in the scientific community and various industries. However, these materials are usually very brittle and not machinable and for this reason there has been no large scale applications of these metal oxide superconductors in industry. Attempts at improving the machinability have

included adding precious metals such as silver, gold and platinum, but these are extremely expensive processes. Therefore there is a need to provide high temperature superconductors that are nonbrittle, machinable and also relatively inexpensive to manufacture.

SUMMARY OF THE INVENTION

In view of the above needs, it is an object of this invention to provide metal oxide superconductors that are nonbrittle.

It is another object of this invention to provide metal oxide superconductors that are machinable.

Additional objects, advantages and novel features of the invention will be set forth in part in the description which follows, and in part will become apparent to those skilled in the art upon examination of the following or may be learned by practice of the invention. The objects and advantages of the invention may be realized and attained by means of the instrumentalities and combinations particularly pointed out in the appended claims.

To achieve the foregoing and other objects and in accordance with the purpose of the present invention, as embodied and broadly described herein, the composition of this invention may comprise a metal oxide superconductor having a sufficient amount of an alloying element selected from the group consisting of indium, tin, and aluminum to result in a superconducting material that is machinable. The preferred superconductors are $YBa_2Cu_3O_{7-x}$ and Bi-Sr-Ca-Cu-O compounds that include $Bi_2Sr_2Ca_2Cu_3O_{10+x}$ and $Bi_2Sr_2CaCu_2O_{8+x}$. It is believed that the preferred amount of the alloying elements is between about 10 and 80 mol% of the alloy.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Powders of metal oxide high-T_c superconductors such as $YBa_2Cu_3O_{7-x}$ and Bi-Sr-Ca-Cu-O compounds are mixed with metal powder such as In, Sn or Al. The well mixed powders are pressed into pellets which are then heated in a high pressure oxygen environment at temperatures usually at about 50°C higher than the melting points of the metal elements. The formula ratios of mixtures are usually set as 1:2 between metal oxide and alloying elements.

The composition and process described in the following example is intended to be illustrative and not in any way a limitation on the scope of the invention. Persons of ordinary skill in the art should be able to envision variations on the general principle of this invention that fall within the scope of the generic claims the follow.

The time, temperature and other parameters required for various steps in the process will be expected to vary according to the size, shape, specific composition, and other properties of the article or other components involved in the process steps. Parameters may also be affected by variations in equipment used or in other conditions present in the process environment. The term "sufficient" and its derivatives are used to indicate expected allowances for these variations.

Example

Three grams of $YBa_2Cu_3O_{7-x}$ powder and 1.07 g of In powder were mixed and then pressed into a pellet under pressure of a few tons per square centimeter, the exact pressure not being critical. The pellet was heated at 250°C in flowing oxygen gas for 4 hours. The pellet was then ground into a powder and stirred to assure homogeneity of the mixture. The powder was again pressed into a pellet under a pressure of 5 tons/cm^2 and then heated to about 180°C for 8 hours. The final product was a good conductor at room temperature and the T_c was the same as the unalloyed superconductor. The result was an improved superconductor capable of being machined into desired shapes and sizes.

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ABSTRACT

Metal oxide superconductors that are made machinable by alloying additions of indium, tin or aluminum.