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3,466,155

CHROME ALLOYS

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6 Claims

ABSTRACT OF THE DISCLOSURE

A chromium alloy composite utilizing additives of magnesium oxide, silicon, titanium, vanadium, tantalum and carbon with chromium powder that is screened through a 200–325 mesh screen which is blended with all or some of the additives, compacted, broken up, recomacted and sintered.

Summary

The prior art has known that some of the physical characteristics of commercially prepared metals can be improved upon if the metal is caused to be substantially free of all impurities such as: hydrogen, nitrogen, carbon, sulphur, oxygen and perhaps in some instances the inert gases. These impurities, for example, tend to make numerous metals brittle to such an extent that in many instances the metals could not be used commercially. It has been extremely difficult heretofore to rid metals substantially of the contaminants above enumerated; so that metals of high purity have not been available to the metal fabricating arts; and so that, in some instances, the true physical properties of some pure metals have not even been known precisely.

Prior art attempts at purifying metals is shown in U.S. Patent No. 3,175,279 assigned to the common assignee of this invention which related to spinels or spinel-like oxide formations in finely divided form distributed throughout a metal body with the metal body being held at elevated temperatures for a period of time so that the spinels act as "getters" or repositories for even minute amounts of impurities.

This invention is primarily concerned with the improvement of this prior art by providing a chromium composite which has improved high temperature atmospheric contamination resistance and strength while maintaining reasonable room temperature tensile ductility.

It is a more particular concern of this invention to suggest a better balance of a chromium composite between the strengthening agent and the useable ductility required for the fabrication of products.

Detailed description

In accordance with the tenants of this invention a chromium composite with improved oxidation-nitridation resistance and having a high ductility was demonstrated by a process as follows:

Chromium powder was screened through a 200 mesh screen and powders of magnesium oxide, 3% by weight; vanadium, 2.5% to 3.0% by weight; and silicon, 0.5% by weight, is added to the chromium powder. This composite mixture is placed in a blender, such as an elbow blender familiar to those skilled in the art, and blended for 10 minutes. Upon removal from the blender it is screened through a 200 mesh screen and then reblended, as before.

The blended, composite mixture is placed in a closed die and precompactd at 25,000 lbs., for example. Then the compacted, composite mixture is broken up and hydrostatically pressed at 20,000 p.s.i., for example, into a billet.

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The resulting billet is sintered at 2750° F. for 4 hours in a 1 micron or less vacuum. The billet can then be turned on a lathe to a more desirable shape, and then flame sprayed, if desired, with a nickel cladding after which it is placed in an electric furnace for 1 hour at 2200° F. Upon removal from the electric furnace the billet's area is reduced by extrusion to a 7 to 1 ratio. It should be noted that the magnesium oxide powder used in the creation of the aforementioned example was a fused magnesium oxide rather than a chemically precipitated magnesium oxide. It was found that a fused grade has impurities added during manufacture to aid in melting which increased resistance to contamination and spalling of scale. The impurities noted in the fused magnesium oxide utilized in the examples made thus far included calcium, silicon and iron in a total amount of about 3.5% by weight.

Another example of a similar chromium composite but having improved strength was found by utilizing chromium metal powder and additives that have been screened by a —325 mesh screen. Thereafter the mixture was placed in an elbow blender for 10 minutes, which additives included: magnesium oxide, 3% by weight; silicon, 1% by weight; titanium, 0.5% by weight; vanadium, 2.5% by weight; tantalum, 2% by weight; carbon, 0.5% by weight. After the blending operation the composite is screened through a 200 mesh screen and then blended again for approximately 10 minutes. This composite of powders is placed in a closed die and precompactd at 25,000 p.s.i., for example. Resulting material is thereafter passed through a 60 mesh screen and pressed hydrostatically at 20,000 p.s.i. into a cylindrical billet. The billet is sintered at 2800° F. for 3 hours in a 1 micron vacuum, machined to a more desirable shape, and can be flame sprayed with nickel cladding for protective purposes, as with the previous example. Thereafter, the billet is heated for 1 hour at 2200° F., and it is extruded after this heat treatment at an 8 to 1 ratio. Again the magnesium oxide employed is preferably of the fused variety rather than the chemically precipitated material.

It will be appreciated by those skilled in the art to which this invention relates that the sintering temperature and vacuum level in the foregoing examples may vary and in such situations so too would the duration of such operation.

It may also be appreciated that the first of the two examples provided an extremely good ductility characteristic for the resultant composite, and the second example increased the strength of the composite with some sacrifice in ductility. In closing, it has been realized that the composition(s) above described have increased the service life 400% for fixtures for temperature sensors in high temperature applications; i.e., temperature above 2000° F.

Having fully described a construction of the invention in detail, it is our intention to cover hereby all novel adaptations, modifications and arrangements thereof which will occur to those skilled in the art.

We claim:

1. A ductile sintered composite consisting essentially of chromium having finely divided particles of magnesium oxide, vanadium and silicon uniformly distributed therein to comprise no less than 6% and no more than 7% of the total percent by weight of the resultant composition.

2. A composite according to claim 1 and further comprising additives of titanium, tantalum and carbon uniformly distributed as with the additives of magnesium oxide, vanadium and silicon with the chromium powder which combination of additives comprise no less than 9% and no more than 10% of the total percent by weight of the composition.

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3. A composite according to claim 1 wherein said magnesium oxide is a fused compound containing impurities of calcium, silicon and iron of substantially 3.5% of the total percent by weight of the magnesium oxide.

4. A composite according to claim 2 wherein said magnesium oxide is a fused compound containing impurities of calcium silicon and iron of substantially 3.5% of the total percent by weight of the magnesium oxide.

5. The composite of claim 1 and further comprising a nickel cladding for protective purposes.

6. The composite of claim 2 and further comprising a nickel cladding for protective purposes.

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