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[54] **MASKING METHOD IN METALLIC DIFFUSION COATING**

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[58] **Field of Search** ....117/5.5, 107 R, 107 P, 38, 117/107.2

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[57] **ABSTRACT**

A metallic article surface, not intended to be coated during a metallic diffusion coating method employing a halide vapor to carry coating elements, is protected with a masking material including a compound which has an energy of formation less than the energy of formation of a halide of a metallic element of the compound. Examples of the compound are the oxides of Ca, Mg and Ba.

3 Claims, No Drawings

MASKING METHOD IN METALLIC DIFFUSION COATING

In order to extend the life of articles such as the hot operating metallic components of a gas turbine engine, various types of protective coatings have been applied to article surfaces. A widely used coating type is one in which a metallic coating is diffused into and diffusion bonded with the surface of the article to result in an integrally bonded protective coating. This type of coating sometimes is referred to as a "metallic diffusion coating".

Although it is desirable to apply metallic diffusion coatings to certain surfaces of articles, other surface areas are intended to remain free of coating. For example, surface areas operating at relatively low temperatures or which cooperate in joining the coated article to another member may operate more efficiently when uncoated. Therefore, during the process of applying metallic diffusion coatings, certain areas of an article must be masked or separated from contact with the coating media.

One type of metallic diffusion coating system is described in copending application Ser. No. 693,691 filed Dec. 14, 1967, now U.S. Pat. No. 3,540,878, issued Nov. 17, 1970 and assigned to the assignee of the present invention. Described in that copending application is a ternary alloy consisting essentially of, by weight, about 50–70% Ti, 20–48% Al, and 0.5–9% combined carbon. Such a ternary alloy is used in a metallic diffusion coating method employing a halide, preferably chlorides and fluorides of ammonium and of the alkali metals of group I A of the periodic table of elements. The halide reacts with the ternary alloy metallic elements such as titanium or aluminum or both, to form a halide of those elements. That halide reacts with a metallic article surface to be coated, depositing the coating elements and regenerating the halide. Specifically preferred in that method are NaF, KF, NH_4Cl and NH_4F. Such a method is particularly useful in coating metallic surfaces, such as the superalloys based on one of the elements Fe, Ni and Co.

Metallic diffusion coating methods such as the one described above and in the above identified patent, are conducted at elevated temperatures, for example at least about 1,400° F. and generally in the range of about 1,600°–2,100° F. Therefore, masking materials must be thermally stable in that range for the period in which they are intended to operate.

Mechanical devices for protecting article surfaces from coating during such a method are cumbersome and costly. Sometimes they are ineffective because of the penetrating characteristics of the halide vapor used in the coating method.

It is a principal object of this invention to provide an improved method for masking a metallic surface during practice metallic diffusion coating employing a halide vapor to carry the coating.

Another object is to provide a masking method employing masking material which is inert with respect to the metallic surface to which it is applied during operation of the metallic diffusion coating method and which preferentially reacts with the halide vapor carrying the coating elements.

Still another object is to provide a masking material for such a method which is easily applied and easily removed from such metallic article surfaces.

These and other objects and advantages will be more fully understood from the following detailed description and examples which are representative of the invention defined by the appended claims.

It has been recognized that a masking material, which can satisfy the above and other objects, includes a compound which has an energy of formation less than the energy of formation of a halide of a metallic element of that compound. Thus during practice of the metallic diffusion coating method, such a compound applied to a surface which is not intended to be coated will react preferentially with the halide vapor carrying the coating elements to form a halide of a metallic element of that compound rather than remain in its original compound form. This action protects the article surface from contact with the halide vapor and hence from deposition of the coating elements carried by the vapor on such masked article surface. Specifically preferred compounds for use in such masking material are compounds selected from the oxides of Ca, Mg and Ba.

A variety of halides can be used in the type of metallic diffusion coating method to which the present invention relates. One of the more widely used types and the one which has been selected as a typical example is the fluoride which results from use of NH_4F in the practice of the method described by the above identified copending application. In that method, reaction of NH_4F with aluminum or titanium or both will form such fluorides as AlF_3 and TiF_3.

CaO can be selected as the compound to provide masking in the practice of the method of the present invention. If CaO is contacted at elevated temperatures by a fluoride such as the aluminum or titanium fluorides described before, CaF_2 will form. Such formation is in accordance with the relative energies of formation of CaO and CaF_2. Thus, masking of an article surface with CaO eliminates from potential coating reaction the fluoride vapors of aluminum and titanium through chemical reaction with CaO before such vapors reach the article surface. Therefore potentially useful as a masking compound in the practice of the present invention is any metal compound nonreactive with the article surface, and which favors the formation of another metal fluoride in the reaction with the fluoride coating element vapors, such as of aluminum, titanium, etc. In the evaluation of the present invention, it has been recognized that, in addition to CaO, other compounds which can be used are MgO and BaO.

Masking materials used in the evaluation of the present invention were prepared by mixing the selected compound in powder form with a solvent and binder which will decompose upon heating. This provided a slurry which was applied to an article surface by brushing, dipping or spraying. One specific binder used was an acrylic resin in acetone or in toluol, forms of which are commercially available and widely used with brazing powders.

In one series of tests, such slurries were applied by spraying to a thickness of between about 0.1–0.2 inches. After spraying, the specimens were exposed to a coating cycle, as described in the above identified application, at 1,925° F. for from 2–4 hours. After exposure in such a coating cycle, the masking slurry was removed by scrubbing the specimens in hot water with a bristle brush.

Metallographic examination of the coatings, coating/masking junctions and masked areas revealed the masking material and method of the present invention to be very effective. The coating was restricted to the unmasked areas freely exposed to the halide vapors. In addition, and particularly through the use of CaO, the diminishing coating thicknesses at the coating/masking junctions were found to extend over not more than about 0.01 inches on the specimen surfaces.

Although as will be understood by those skilled in the art, the applied thickness of the masking compound is dependent upon the time of exposure to the halide vapors, it has been found that masking compound applied in thicknesses of about 0.1–0.2 inches is adequate for exposure in the range of up to about 2,000° F. at least for about 2–4 hours. Thus if brushing is the method selected for the application of the masking material, a plurality of applications may be required to build up sufficient masking material thickness.

CaO, MgO and BaO alone or in their combination or in combinations with other materials, for example $Ba(OH)_2$, have been found to be effective masking compounds in the practice of the present invention. However, not all oxides can be so used. For example, evaluation has disclosed that masking compounds consisting of WO_3 and MoO_3 are not effective in masking. In addition, NiO reduced to Ni which had a tendency to react with nickel base surfaces. Therefore, preferred as a masking compound in the practice of the method of the present invention is an oxide selected from those of Ca, Mg and Ba; specifically preferred is CaO as a compound in the masking material.

What is claimed is:

1. In a metallic diffusion coating method of applying a metallic diffusion coating to a first metallic surface of an article as a result of contact between the first surface and a halide vapor carrying a metallic diffusion coating element, the steps of:

applying to a second metallic surface of the article, and on which the metallic diffusion coating is not intended to be applied, a masking material which is inert with respect to the second metallic surface during operation of the metallic diffusion coating method and including a compound selected from the group consisting of the oxides of Ca, Mg and Ba, which will react preferentially with the halide vapor carrying the metallic diffusion coating element and which has an energy of formation less than the energy of formation of a halide of a metallic element of the compound; and then

applying to the article and in contact with the first surface the halide vapor carrying the metallic diffusion coating element in a nonoxidizing atmosphere in the temperature range of at least about 1,400° F.;

whereby the coating element is deposited on the first surface and the halide vapor carrying the metallic diffusion coating element reacts with the compound to form the halide of the metallic element of the compound.

2. The method of claim 1 in which:

the halide vapor is selected from the group consisting of the chlorides and fluorides of ammonium and of the alkali metals of group I A of the periodic table of elements.

3. The method of claim 2 in which:

the metallic diffusion coating element is selected from the group consisting of Al, Ti and their alloys;

the first and second metallic surfaces are based on the elements selected from the group consisting of Fe, Ni and Co; and

the temperature range is about 1,600°–2,100° F.

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