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(12) # EUROPEAN PATENT SPECIFICATION

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(54) **Titanium nitride dispersion strengthened bodies.**

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Description

This invention relates to bhe production of titanium nitride dispersion strengthened bodies.

The strengthening of titanium containing alloys by gas-phase nitriding to produce a dispersion of titanium nitride is now an established procedure but the nitriding of thick sections remains a problem because the kinetics are so slow. British Patent No. 1,434,729 describes a method of making an austenitic steel artefact by gas-phase nitriding.

According to the present invention a method of production of a titanium nitride dispersion strengthened body involves the steps of producing a porous body from titanium containing alloy powder and then causing a flowing mixture of nitrogen and hydrogen to permeate the permeable matrix of powder particles so formed so as to effect nitriding of the titanium. The porous body is produced by heating the powder in a hydrogen-containing atmosphere to achieve partial sintering, i.e. sintering of the particles to such an extent that the body or matrix is permeable to the nitrogen/hydrogen gas flow and is sufficiently self-supporting to withstand the flow pressure. A suitable temperature for the partial sintering is in the range of 900—1250°C.

The initial porous bodies are preferably disc-shaped and may be formed by heating the powder in the container in which it is to be nitrided, or in a separate container of similar shape.

Another method of producing the porous sinter may be by causing the powder, in a semi-molten atomised form, to impinge and accumulate on a collecting plate. The bodies so formed will tend to be irregular in shape and may need machining to fit the nitriding container.

As previously mentioned the porous sinter must have sufficient strength not to disintegrate during the nitriding stage and sufficient interconnected porosity to allow access of the nitriding gas.

A suitable temperature for nitriding is in the range 1000 to 1150°C. After nitriding the body is preferably degassed in hydrogen to reduce the excess nitrogen in solid solution.

In one example of the invention, the nitrided alloy is used in the production of a tie bar of round section. In this case, the alloy powder may initially be produced as a plurality of disc-shaped green compacts which are then subjected to the aforesaid partial sintering and nitriding steps. Thereafter a quantity of the discs so formed may be inserted into an extrusion container and consolidated, by extrusion, into a round-section rod or bar.

In another example, a quantity of the porous bodies may be consolidated, e.g. by a rolling technique, into sheet form. It will be understood that various other methods of consolidating quantities of the porous bodies into desired shapes may be employed.

If desired, after nitriding the porous bodies may once again be reduced to powder, as by comminuting, for use in conventional powder metallurgy forming techniques. It is thought that the nitrided powder will exhibit less susceptibility to oxidation at room temperatures than titanium oxide dispersion-strengthened powders which require special handling, e.g. in inert atmospheres, to prevent oxidation at room temperatures.

The invention has particular application to the nitriding of titanium-containing austenitic and ferritic steel powders, especially 20% Cr/25% Ni/Ti powder. Thus, according to a further aspect of the invention there is provided a titanium-containing steel powder-formed body which has been produced in accordance with the method of the invention. The invention also extends to components consolidated from said bodies and to powder derived by comminution of said bodies.

Claims

1. A method of production of a titanium nitride dispersion strengthened body comprising the steps of producing a porous body from titanium containing alloy powder by heating said powder in a hydrogen-containing atmosphere to achieve partial sintering to the extent that a matrix is produced which is permeable to the flow of nitrogen/hydrogen mixture and then causing a flowing mixture of nitrogen and hydrogen to permeate the said matrix so as to effect nitriding of the titanium, the said matrix being sufficiently self-supporting to withstand the flow pressure.

2. A method according to Claim 1, characterised in that partial sintering is carried out at a temperature within the range 900—1250°C.

3. A method according to any of the preceding claims, characterised in that nitriding is carried out at a temperature within the range 1000—1150°C.

4. A method according to any of the preceding claims, characterised in that after the nitriding step the body is degassed in hydrogen to reduce excess nitrogen in the solid solution.

5. A method according to any of the preceding claims, characterised by the further steps, to produce a structural article of round section, of subjecting a plurality of said bodies which are of disc-shaped form to consolidation and extrusion.

6. A method according to any of Claims 1—4, characterised by the further step, to produce a structural article in sheet form, of subjecting a plurality of said bodies to consolidation by rolling out into sheet.

7. A method according to any of Claims 1—4, characterised by the further steps of comminuting a plurality of said bodies and forming structural articles to desired shapes by conventional power metallurgy forming techniques.

Patentansprüche

1. Verfahren zur Herstellung eines durch eine Titannitrid-Dispersion verstärkten Körpers, bei

dem man einen porösen Körper aus einem titanhaltigen Legierungspulver hergestellt, indem man das Pulver in einer wasserstoffhaltigen Atmosphäre erhitzt, um eine teilweise Sinterung bis zu dem Ausmaß zu erhalten, bei dem eine Matrix erzeugt wird, die durchlässig für einen Stickstoff-/Wasserstoffmischungs-Strom ist und dann bewirkt, daß eine strömende Mischung aus Stickstoff und Wasserstoff die Matrix durchdringt, um die Nitridhärtung des Titans zu bewirken, wobei die Matrix ausreichend selbsttragend ist, um dem Stömungsdruck zu widerstehen.

2. Verfahren nach Anspruch 1, dadurch gekennzeichnet, daß die teilweise Sintering bei einer Temperatur im Bereich von 900 bis 1250°C durchgeführt wird.

3. Verfahren nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, daß die Nitridhärtung bei einer Temperatur im Bereich von 1000 bis 1150°C durchgeführt wird.

4. Verfahren nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, daß nach dem Nitridhärtungsschritt der Körper in Wasserstoff entgast wird, um überschüssigen Stickstoff in der festen Lösung zu vermindern.

5. Verfahren nach einem der vorhergehenden Ansprüche, gekennzeichnet durch die weiteren Schritte, um einen Konstruktionsgegenstand mit rundem Querschnitt herzustellen und eine Vielzahl der scheibenförmigen Körper einer Verfestigung und Extrusion zu unterwerfen.

6. Verfahren nach einem der Ansprüche 1 bis 4, gekennzeichnet durch den weiteren Schritt um einen Konstruktionsgegenstand in Blattform herzustellen, und eine Vielzahl der Körper durch Ausrollen in eine Platte einer Verfestigung zu unterwerfen.

7. Verfahren nach einem der Ansprüche 1 bis 4, gekennzeichnet durch den weiteren Schritt der Vermahlung einer Vielzahl der Körper und Bildung von Strukturgegenständen in die erwünschten Formen durch herkömmliche Pulvermetallurgie-Formungstechniken.

Revendications

1. Procédé de production d'une ébauche renforcée par une dispersion de nitrure de titane, ce procédé comprenant les étapes consistant à produire un corps poreux, ou une ébauche poreuse, à partir d'une poudre d'alliage contenant du titane, par chauffage de ladite poudre dans une atmosphère contenant de l'hydrogène, afin de réaliser un frittage partiel dans la mesure où l'on produit ainsi une matrice qui est perméable à l'écoulement du mélange d'azote/hydrogène, et à obliger ensuite un mélange d'azote et d'hydrogène en écoulement à traverser par perméation ladite matrice de façon à réaliser la nitruration du titane, ladite matrice pouvant suffisamment se supporter elle-même pour résister à la pression appliquée par l'écoulement.

2. Procédé selon la revendication 1, caractérisé en ce qu'on conduit le frittage partiel à une température comprise entre 900 et 1250°C.

3. Procédé selon l'une quelconque des revendications précédentes, caractérisé en ce qu'on conduit la nitruration à une température comprise entre 1000 et 1150°C.

4. Procédé selon l'une quelconque des revendications précédentes, caractérisé en ce que, après l'étape de nitruration, on soumet l'ébauche à un dégazage dans de l'hydrogène pour diminuer l'excès d'azote présent en solution solide.

5. Procédé selon l'une quelconque des revendications précédentes, caractérisé par les étapes supplémentaires consistant à produire un article structurel de section ronde, à soumettre plusieurs de ces ébauches, qui sont sous forme de disques, à consolidation et extrusion.

6. Procédé selon l'une quelconque des revendications 1 à 4, caractérisé par l'étape supplémentaire consistant, pour produire un article structurel sous forme de feuille ou de tôle, à soumettre plusieurs ébauches à consolidation par laminage ou roulage afin d'obtenir une feuille.

7. Procédé selon l'une quelconque des revendications 1 à 4, caractérisé par les étapes supplémentaires consistant à fragmenter plusieurs desdites ébauches et à former les articles structurels, en leur donnant les formes voulues, par des techniques classiques de formage par la métallurgie des poudres.