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Datasheet for the decision of 20 July 2007

Case Number: T 0849/05 - 3.2.03

Application Number: 97933048.7

Publication Number: 0856370

IPC: B22F 9/04

Language of the proceedings: EN

Title of invention:
Titanium-base powder and process for the production of the same

Applicant:
TOHO TITANIUM CO., LTD.

Opponent:
-

Headword:
-

Relevant legal provisions:
EPC Art. 56

Keyword:
"Inventive step (no)"

Decisions cited:
-

Catchword:
-

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Case Number: T 0849/05 - 3.2.03

D E C I S I O N
of the Technical Board of Appeal 3.2.03
of 20 July 2007

Appellant: TOHO TITANIUM CO., LTD.
3-3-5, Chigasaki
Chigasaki-shi
Kanagawa 253 (JP)

Representative: Nöth, Heinz
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Decision under appeal: **Decision of the Examining Division of the European Patent Office posted 18 February 2005 refusing European application No. 97933048.7 pursuant to Article 97(1) EPC.**

Composition of the Board:

Chairman: U. Krause
Members: G. Ashley
K. Garnett

Summary of Facts and Submissions

I. European patent application EP-A1-0 856 370 concerns titanium hydride powders, and this appeal arises from the decision of the examining division to refuse the application for lack of inventive step in light of the following prior art:

D1: E. Fukasawa et al, "Characteristics of High Purity Titanium Powder by HDH Process", in "Titanium 92 Science and Technology" edited by F. H. Froes and I. Caplan, The Minerals, Metals and Materials Society, 1993, pages 919 to 926.

D2: JP-A-5247503, including an English language abstract and a computer-generated translation.

II. The decision was posted by the examining division on 18 February 2005; the appellant (applicant) filed notice of appeal on 15 April 2005, paying the appeal fee at the same time; a statement containing the grounds of appeal was filed on 24 June 2005.

III. In accordance with Article 11(1) of the Rules of Procedure of the Boards of Appeal, the Board issued a preliminary opinion together with a summons to attend oral proceedings, setting out its view on inventive step. The oral proceedings were duly held on 20 July 2007.

IV. The appellant requested that the decision under appeal be set aside and a patent be granted on the basis of the amended set of claims filed during the oral proceedings.

V. Claim 1 reads as follows:

"1. A titanium hydride powder or titanium hydride alloy powder comprising:
an oxygen content of 0.15% or less by weight, and
a chlorine content of 0.06% or less by weight,
wherein amount of the powder with particle diameters of 150 μm or less is 99% or more by weight, and amount of the powder of particles with a diameter of 10 μm or less is 8% or less by weight."

Dependent claims 2 and 3 concern preferred embodiments of the powder of claim 1. Independent claim 4 and dependent claim 5 are directed to a process for producing a titanium hydride or titanium hydride alloy powder.

VI. Submissions of the Appellant

The application relates to the production of titanium powders by the hydride-dehydride (HDH) process. According to this process, ductile titanium metal is converted into brittle titanium hydride by the introduction of hydrogen; the titanium hydride is ground to a powder and then dehydrogenated to produce titanium powder. Chlorine and oxygen are impurity elements in titanium powders, which, according to the appellant, reside particularly in the fine particle fraction. The application concerns the nature of the titanium hydride powder, and discloses that the purity of the final titanium powder product can be improved by reducing the amount of fine particles in the intermediate titanium hydride powder. The appellant

submits that removal of the fine fraction also has a beneficial effect on the flowability and compactibility of both the titanium hydride and titanium powders.

The examining division considered D1 to be the most relevant document, as it discloses high purity titanium powders produced by the hydride-dehydride (HDH) process. The impurity content and the size distribution of the hydride starting powder of D1 are not explicitly disclosed; however, the examining division argued that the skilled person would seriously contemplate working with a hydride powder having an impurity level similar to that required in the titanium powder end product. The examining division thus considered that the powder of claim 1 is novel with respect to the overall disclosure of D1 only by virtue of its size distribution.

The problem to be solved was viewed as being how to provide a process for obtaining high purity titanium. D2 discloses a titanium hydride powder for producing titanium in an HDH process and teaches that a low fine fraction serves to limit the impurity content of the titanium powder. Hence the skilled person starting from D1 and seeking to solve the above problem would adopt the low fine fraction of D2 and thereby fall within the particle size range given in claim 1.

The appellant holds the view that the particle size distribution of the titanium powder is not the same as that of the titanium hydride powder, and no assumption about titanium hydride particle sizes can be made from knowledge of the titanium powder size distribution. In D1 the amount of titanium powder having a particle size

of 45 μm or less is 5.0 wt%. The high purity powder is achieved by removing a large amount of fine titanium particles once dehydration has taken place, with the titanium hydride powder having a greater degree of impurity than the titanium powder. Therefore no conclusions about the impurity level of the titanium hydride powder can be made from D1.

According to the appellant, D2 does not provide any indication of a solution to the problem of providing a suitable titanium hydride powder as the starting product for producing high purity titanium powder. The titanium hydride powder of D2 requires that particles of 45 μm or less are limited to 30 wt.%, whereas claim 1 defines particles of 10 μm or less as being limited to 8 wt.%.

There is no teaching in D2 of reducing the chlorine content of the titanium hydride powder, and the document is silent as regards the effect of limiting the particle size on compressibility and flowability of the powder.

Since there is no indication in D2 that a titanium hydride powder having the claimed particle size distribution reduces the oxygen and chlorine content of the subsequent titanium powder, and the flowability and compressibility of both titanium and titanium hydride bulk powders is also improved, the claimed subject-matter has an inventive step.

Reasons for the Decision

1. The appeal is admissible.

Inventive Step (Article 56 EPC)

2. The application addresses the problem of reducing oxygen and chlorine impurity levels in titanium powders made by the HDH process, as well as improving the flowability and compactability of titanium and titanium hydride powders (see page 2 of the published application, lines 53 to 56). The proposed solution is a titanium hydride powder having the features set out in claim 1.

3. Document D1 focuses on the titanium powder end product rather than the intermediate titanium hydride powders used to make the titanium powder. Based on the information given about the titanium powder in D1, the examining division made assumptions about the nature of the titanium hydride precursor. However, the appellant has explained that particle size distribution and the oxygen and chlorine contents of the titanium powder need not correspond to those of the titanium hydride powder, especially as the amount of impurities in the titanium powder can be reduced by removing small titanium particles without having any influence on the distribution of titanium hydride particles. Given the lack of certainty in relating the particle sizes of titanium powder to those of the titanium hydride powder, and that document D2 specifically discloses titanium hydride powder, the Board considers that D2 provides a more appropriate starting point for the assessment of inventive step.

4. D2 describes the HDH production of high purity titanium or titanium alloy powder having a low oxygen content. According to D2, oxygen levels within the claimed range (see Tables 1 and 2 of D2) are achieved by adjusting the amount of titanium hydride powder with a particle size of 45 μm or less to 30 wt.% or less. Claim 1 of the present application, on the other hand, defines the fine fraction of titanium hydride powder as having 8 wt.% or less of particles with diameters of 10 μm or less; claim 1 also defines the chlorine content of the powder, whereas D2 is silent on this matter.

5. Starting from D2, the objective problem is seen as how to improve the properties of the powder.

5.1 Regarding the oxygen and chlorine content of the powder, the English computer-generated translation of D2 discloses that fine particles are removed from the titanium hydride powder in order to prevent an increase in oxygen content during dehydrogenation and subsequent processing steps (see paragraphs [0006] and [0010]). A large proportion of fine particles has a relatively large surface area, hence their removal reduces the tendency of the powder to absorb oxygen. Their removal would, however, also reduce the amount of oxygen already existing in the powder. In addition, not only would the oxygen level be reduced, but, as an inevitable consequence, the chlorine content would also be reduced, since a relatively high proportion of chlorine in a bulk powder also resides in the finer particle fraction; the appellant's argument that D2 does not concern the reduction in chlorine content and

provides no indication of either the problem or its solution is therefore not persuasive.

5.2 The above view of the Board concerning reduction of impurities in the titanium hydride powder was set out in the communication accompanying the invitation to oral proceedings. During the oral proceedings before the Board, the applicant argued that the heart of the invention lay not in reducing the impurity level, as the skilled person always aims at having the lowest impurity content as possible, but rather in improving the flowability and compactability of the powder.

The application states (see page 3, lines 15 to 18 of the published application) that with the increase in fine powder, the flowability of the powder is lowered, and that the compactability of the fine powder is also lowered as a result of the adverse effect of oxidised fine powders. Thus the powder of the invention limits the ratio of particles having a diameter of 10 μm or less to 8 wt.% or less. The appellant argued that the claimed size ratio for fine particles is about 4 times larger than that of D2, and its effect on flowability and compactability is clearly demonstrated in Table 1 of the application. The selected particle size range is therefore not an arbitrary example of the prior art, but a purposive selection with respect to improving flowability and compactability, which enables the titanium hydride powder to be used directly as a raw material for a compact, with the compact rather than the powder being subsequently dehydrogenated.

The flow property of a bulk powder is mainly determined by the free movement of particles in contact with their

neighbours, and hence is largely influenced by the shape and size of the particles and inter-particle friction. The skilled person is generally aware that the presence of a large proportion of fine particles in any powder will increase inter-particle friction and have an adverse effect on the flow rate. Faced with the problem of improving the flow rate of the powders of D2, it would be an obvious step within the general knowledge of the skilled person to reduce further the amount of fines.

Considering the compactability, the presence of oxide films on the surfaces of the particles has an adverse effect. Thus compactability is closely linked to the oxygen content. D2 teaches that oxygen content should be reduced, and in particular the fine fraction of particles that have a relatively large surface area susceptible to oxygen absorption should be removed. It would therefore be expected that, by virtue of their low oxygen content and low fraction of fine particles, the titanium hydride powders of D2 would also exhibit the desired compactability.

The Board does not agree with the appellant's assertion that the claimed range of fine particles relates to a narrow selection from D2, which unexpectedly solves a problem not mentioned in D2. The effects described in the present application are either disclosed, explicitly or implicitly in D2, or result from obvious measures. The conclusion is therefore that the subject-matter of claim 1 lacks an inventive step.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

A. Counillon U. Krause