INTEGRAL TITANIUM BORIDE COATINGS ON TITANIUM SURFACES AND ASSOCIATED METHODS

Abstract: A borided titanium article can include a titanium mass having titanium monoboride whiskers infiltrating inward from a surface of the titanium mass to form an integral surface hardened region. The titanium mass can be almost any titanium based metal or alloy such as high purity titanium, commercial grade titanium, alpha-titanium alloy, and combinations thereof. Borided titanium articles can be formed by methods which include providing a titanium mass, contacting a surface of the titanium mass with a boron source medium, and heating the titanium mass and boron source medium to a temperature from about 700 °C to about 1600 °C. The boron source medium can include a boron source and an activator selected to provide growth of titanium monoboride whiskers. The boron source medium can be provided as a solid particulate mixture, liquid mixture, or as a gaseous mixture. During heating, boron from the boron source infiltrates into the titanium mass and forms titanium monoboride whiskers which improve the surface hardness, wear resistance, oxidation resistance, and corrosion resistance of the treated surface. The titanium monoboride whiskers can be controlled to have the desired dimensions, depending on the application requirements. Boriding titanium surfaces using these methods, provides a relatively inexpensive and effective process for improving the surface properties of titanium which are then useful in a wide variety of applications.
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER
IPC(7) : B32B 15/02; C01B 35/04
US CL. : 428/627, 567, 601, 660, 687, 323, 332, 627, 704, 689;420/126, 129, 417, 121; 423/411, 598, 608, 297;
According to International Patent Classification (IPC) or to both national classification and IPC.

B. FIELDS SEARCHED
Minimum documentation searched (classification system followed by classification symbols)
U.S.: 428/627, 567, 601, 660, 687, 323, 332, 627, 704, 689;420/126, 129, 417, 121; 423/411, 598, 608, 297;
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
<thead>
<tr>
<th>Category *</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
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<tbody>
<tr>
<td>Y</td>
<td>US 3,676,371 A (ZOLLNER et al.) 11 July 1972 (11.07.1972) column 1, lines 60-70</td>
<td>1, 10-13, 15-17, 44-45</td>
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<td>A</td>
<td>US 2003/0047463 A1 (WARD-CLOSE et al.) 13 March 2003 (13.03.2003), page 3, paragraph [0046].</td>
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☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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Date of mailing of the international search report: 18 MAY 2004

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