This invention relates to shaped bodies mainly consisting of titanium carbide and containing one or more metals of the iron group (iron, cobalt, nickel) for greater toughness.

Titanium carbide bodies of the composition described above are extremely hard, and have been used successfully as tool bits on machine tools and in other applications in which high wear resistance is essential. The iron metal component gives them not only toughness, but also good resistance to thermal shock. Yet, the mechanical and thermal properties of the known titanium carbide bodies are still quite far from those theoretically expected from the constituents, and particularly the mechanical strength is quite far below the theoretical optimum. It has been impossible heretofore to produce shaped bodies consisting mainly of titanium carbide which are truly dense. A porosity of ten percent or even more is unavoidable.

It has now been found that the porosity of such titanium carbide bodies can be reduced sharply, and that the thermal and mechanical properties improved correspondingly if the metallic phase contains titanium and/or zirconium in an amount of ten to about ninety percent, all percentage values in this specification and the appended claims being by weight unless explicitly stated otherwise. Best results are achieved if the titanium or zirconium content of the metallic phase amounts to 10 to 40 percent, the metal bound to the carbon in the non-metallic carbide phase being excluded from these percentage values and from the base of calculation to which they refer.

The titanium carbide bodies of the invention have a porosity of not significantly more, and usually less than five percent per volume, and they make superior bearing sleeves or metal cutting tools because of their very low wear.

Further improvement can be had in the shaped bodies of this invention by adding one or more metals of Group 6b of the Periodic Table of Elements (chromium, molybdenum, and tungsten) to the metallic phase which amounts to about 10 to 30 percent of the shaped body. Significant effects are achieved with as little as two percent of the Group 6b metal in the metallic phase, and not more than 50 percent thereof may be present without again reducing the mechanical strength of the body. The metals of Group 6b are particularly effective in improving impact and vibration resistance.

The shaped bodies of the invention are prepared from a mixture of the components in finely powdered form which is compacted in the presence of a temporary binder, whereupon the compact is sintered in a hydrogen atmosphere or in a vacuum at a temperature above 1400° C. as is conventional in itself. The titanium or zirconium may be present initially as a powder of the metal or as the powdered hydride which is converted to the metal under the sintering conditions. The sintering conditions can usually be controlled more easily by first preparing an alloy of the metallic ingredients and mixing the powdered alloy with the non-metallic carbide prior to compacting and sintering.

Under some conditions, however, shaped bodies of highest density are achieved when the initial mixture contains the individual components as separate particles, and an alloy of the iron group metal or metals with the titanium or zirconium is formed only during sintering. It has been found that under these conditions the metallic phase is enriched with titanium or zirconium near the interface with the non-metallic carbide phase.

The following examples are further illustrative of this invention, but it will be understood that it is not limited to the examples.

**EXAMPLE 1**

Finely ground titanium carbide was mixed with a powdered alloy of titanium, cobalt, iron, and chromium to make the overall composition of the mixture 85% TiC, 8% Ti, 5% Co, 1% Fe, and 1% Cr. A small amount of an organic binder was added, the mixture was compacted in the usual manner, and the green compact was sintered for 60 minutes in a hydrogen atmosphere at 1550° C.

The thermal and mechanical properties of the shaped body so obtained were substantially superior to the corresponding properties of controls from whose composition the titanium had been omitted. Omission of the chromium resulted in a smaller, but significant loss in quality.

**EXAMPLE 2**

Powdered ingredients were employed in preparing a mixture consisting of 70% titanium carbide, 5% tungsten carbide, 10% molybdenum, 10% nickel, and 5% titanium hydride. The mixture was converted to a green compact as described in Example 1, and the compact was sintered at 1500° C. for 30 minutes.

It was superior in its properties to conventionally prepared controls not containing titanium and/or molybdenum.

**EXAMPLE 3**

The method of Examples 1 and 2 was employed in making shaped bodies of the invention from starting materials having the following compositions:

(A)

<table>
<thead>
<tr>
<th>Component</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Titanium carbide</td>
<td>90</td>
</tr>
<tr>
<td>Zirconium</td>
<td>5</td>
</tr>
<tr>
<td>Cobalt</td>
<td>5</td>
</tr>
</tbody>
</table>

(B)

<table>
<thead>
<tr>
<th>Component</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Titanium carbide</td>
<td>70</td>
</tr>
<tr>
<td>Titanium</td>
<td>27</td>
</tr>
<tr>
<td>Cobalt</td>
<td>3</td>
</tr>
</tbody>
</table>

The mechanical and thermal properties of the resulting sintered material compared favorably with those of otherwise similar materials lacking titanium or zirconium as an essential ingredient.

What is claimed is:

1. A shaped body comprising 10 to 30 percent of a metallic component, the remainder of said body consisting essentially of titanium carbide uniformly mixed with said metallic component, said metallic component
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including 10 to about ninety percent titanium or zirconium, 0 to 50 percent of at least one metal of Group 6b of the Periodic Table of Elements, the remainder of said metallic component consisting of at least one metal having an atomic number between 26 and 28, said last-mentioned metal being present in said metallic component in an amount of at least 10 percent.

2. A body as set forth in claim 1 having voids in an amount not substantially exceeding five percent per volume.

3. A body as set forth in claim 1, wherein metal of said Group 6b is present in an amount of at least 2 percent.

4. A body as set forth in claim 1, wherein said metallic component is an alloy of said titanium or zirconium, said metal of Group 6b, and of said last-mentioned metal.

5. A body as set forth in claim 4, wherein said metallic component contains 10 to 40 percent titanium.

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CARL D. QUARFORTH, Primary Examiner
A. J. STEINER, Assistant Examiner

U.S. Cl. X.R.

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