Tungsten-titanium sputtering targets.

The high atomic weight of tungsten, the high level of corrosion resistance of titanium, its good adhesion to many different surfaces, coupled with the solubility of these materials all go to make tungsten-titanium (WTi) the ideal solution for dense layers to prevent foreign atom diffusion.

That is why WTi with 10 % Ti by weight is used as a diffusion barrier and adhesion layer during the metallization process in microchips fabrication. In this field of application, WTi separates the semiconductor and metallization layers, e.g. aluminium and silicon or copper and silicon.

In flexible thin-film solar cells (CIGS), a WTi barrier layer prevents iron atoms in steel substrate from diffusing through the molybdenum back contact and into the CIGS semiconductor.

Why is that important? Without diffusion barriers, copper and silicon would form an intermetallic phase which would significantly degrade the function of the semiconductor in microchips. And it only takes a few parts per million of iron in the semiconductor to significantly reduce the efficiency of CIGS solar cells. You can read more about this in the paper "CIGS thin-film solar cells on steel substrates".
The two diagrams below illustrate the structure of a CIGS solar cell (left) and the semiconductor metallization on a flip chip (right). In both cases, WTi layers are used where the semiconductor or metallization layer needs to be reliably separated from other layers and good adhesion to the substrate needs to be provided for subsequent layers.

WTi layers are deposited using the PVD sputtering technique. We supply the starting material in the form of sputtering targets. Our material possesses a high density, high material purity and a homogeneous phase composition. We handle every stage of the production process ourselves and monitor all the process steps from the elemental powders right through to the finished target. This means that we are able to guarantee consistently high quality over very long periods.

### WTi from Plansee: Properties at a glance

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density</td>
<td>≥ 98 %</td>
</tr>
<tr>
<td>Purity</td>
<td>&gt; 99.95 %</td>
</tr>
<tr>
<td>Titanium content</td>
<td>10 wt.%</td>
</tr>
<tr>
<td>Homogeneity of the titanium distribution</td>
<td>± 0.5 %</td>
</tr>
<tr>
<td>Microstructure</td>
<td>fine grain, &lt; 50 µm</td>
</tr>
</tbody>
</table>

Our WTi sputtering targets are available in different sizes. Not only do we supply WTi in the form of planar targets; we are one of the first manufacturers to also supply it in the form of fully dense rotary targets. Our WTi targets have a titanium content of 10 wt.%.
The chart below shows the deposition rate of WTi over the sputtering power for a target diameter of 100 mm and an argon pressure of $5 \times 10^{-3}$ mbar.

![Microstructure of a WTi target (SEM image x 200)](image1.png)

![Phase analysis of a WTi target](image2.png)

Red: titanium-rich phase, green: tungsten-rich phase

![Microstructure of the surface of a sputtered WTi layer (SEM image x 50,000)](image3.png)
The high density and purity of our WTi targets help to reduce particle formation during the coating process, which is a critical factor to achieve high quality thin films. The relationship between particle formation and target properties has been investigated in the following scientific papers, among others:

- C.E. Wickersham, Jr., J.E. Poole, J.J. Mueller, Particle contamination during sputter deposition of W-Ti films; J. Vac. Sci. Technol. A 10(4), Jul/Aug 1992