Titanium alloys
Titanium alloys are characterized by a favorable ratio between weight and strength, good ductility, high thermal resilience, corrosion resistance, and biocompatibility. If used as a base material there is significant potential for development in a wide variety of application areas, such as aerospace, the chemical industry, and medical technology, as well as shipping.

Layer development
The tungsten carbide tool coatings developed at the Fraunhofer IST (see Fig. 1) follow the principle for providing a self-lubricating boundary layer during the forming process. Application-oriented laboratory tests (see Fig. 2) prove that this effect causes a significant reduction in tool wear and of the associated friction forces in the contact with adhesive titanium materials (see Fig. 3 and the adjacent graphic). Other long-term tests substantiate a uniform layer performance even for stress durations in the range of industrial applications. These findings indicate that cost-intensive lubricants can be dispensed with and tool life and component quality can be increased. In addition to all major tool steels, temperature-resistant nickel-based materials can be coated with the aid of the PVD technology used. Depending on the tool material selected, operating temperatures of up to 950 °C can be achieved in different atmospheres, such as air, argon, or nitrogen.

Industrial application
Layer development occurred on PVD magnetron sputtering units in accordance with the industrial standard. Thus, the developed coatings can directly be transferred on real forming tools and used for industrial forming processes. The first real forming tests for solid forming and superplastic sheet metal forming of high-strength titanium alloys are currently being conducted with the project partners and should constitute the basis for final qualification of the film systems developed for industrial application.
The project
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Modifications of Inconel718 as tool material in comparison: Tribometer tests versus TiAl6V4 at 950 °C in Ar protective gas atmosphere.

1  SEM micrograph of the developed tungsten-carbide based tool coating.

2  High-temperature tribometer with optional protective gas atmosphere for application-oriented layer development.

3-4  Wear characteristics after application tests versus TiAl6V4 at 950°C under protective gas atmosphere. (3) Uncoated, with adhesion of titanium. (4) Coated, without any adhesion.

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