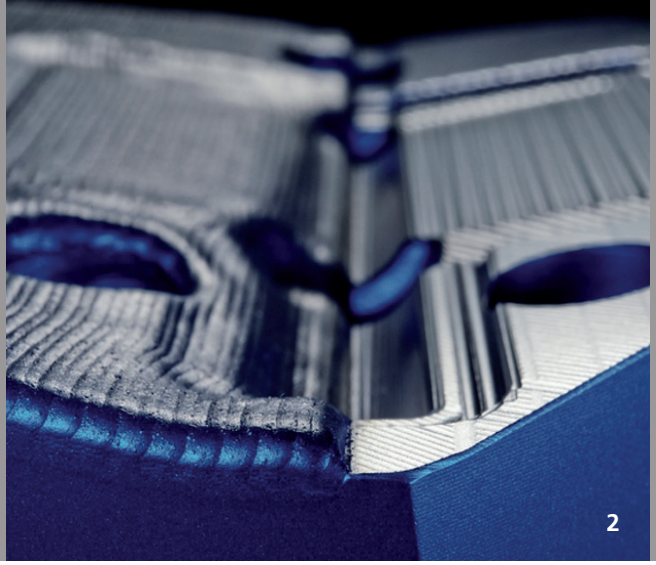

WEAR PROTECTION LAYERS WITH NANOPARTICULATE ADDITIVES FOR TOOLS

Task

The wear protection of molds and tools is becoming increasingly important in manufacturing industry given increasing materials costs and greater demands placed on the manufactured components. In addition to wear protection of new tools, the repair of worn components is playing an ever more significant role. In both cases, wear protection must be tailored to the specific application. In this respect, a compromise between high strength, sufficient toughness and good wear resistance (hardness) must be found.

Method

In order to optimize the thermophysical fit between substrate and layer, a similar material is used as the coating material. The characteristics are modified by means of minimal additions (< 2.5 weight percent) of nanoparticles. Coatings are manufactured from the hot-work steels 1.2365 and 1.2714 with additives made of aluminum and yttrium oxide (20 - 40 nm) as well as titanium carbide, vanadium carbide and tungsten carbide (grain size 80 - 250 nm). The coatings are investigated metallographically in terms of microstructure, porosity and crack formation. Tensile tests and hardness measurements are conducted on test specimens to assess the mechanical properties.

Result

Analysis of the layers shows that nanoparticulate additives of titanium carbide have the greatest effect on the weld quality structure in terms of reducing the grain size. The best mechanical properties can be achieved by adding tungsten carbide. The tensile strength is more than 1700 MPa, with an elongation at rupture of 12 percent and a hardness of 946 HV0.3. This is equivalent to an increase in hardness of approx. 60 percent by adding 2.5 weight percent of tungsten carbide particles. Thus strength and hardness can be increased by adding nanoparticles, while largely maintaining toughness.

Applications

These kinds of layers are particularly suited to areas where thermal or mechanical fatigue develops (forging dies, die-casting molds), as well as areas subject to wear. Field tests with coated forging dies are currently being prepared.

Contacts

Dipl.-Ing. Dipl.-Wirt.-Ing. Sörn Ocylok
Phone +49 241 8906-567
soern.ocylok@ilt.fraunhofer.de

Dr. Andreas Weisheit
Phone +49 241 8906-403
andreas.weisheit@ilt.fraunhofer.de

1 Laser cladding of a tool insert.

2 Coated tool insert.

Fraunhofer Institute for Laser Technology ILT, www.ilt.fraunhofer.de
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