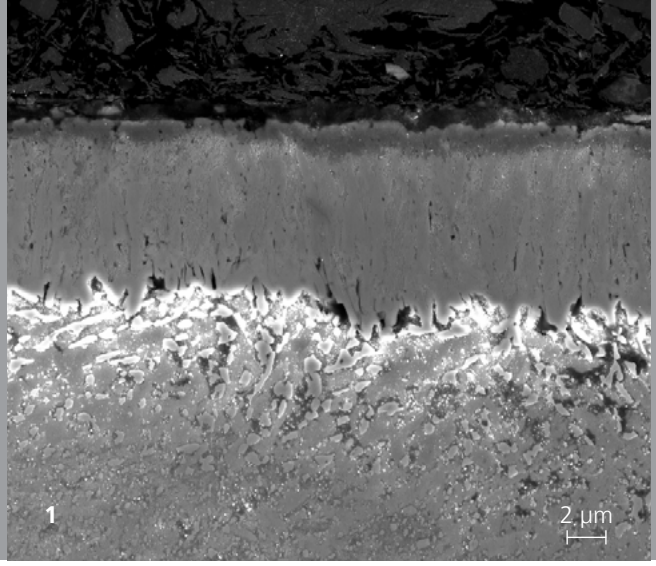

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GAS BORIDING OF HIGH ALLOY TOOL STEELS

Gas boriding of tool steels is an entirely new approach for the wear protection of molds and forming dies. Through newly developed processes at the Fraunhofer IST now high alloy tool steels can also be effectively handled with this process.

Boriding of steel materials

The boriding of low alloy steels has been known for many years. In this process boride is diffused from a powdery or pasty donor medium into the tool surface at temperatures above 750 °C. Subsequent vacuum heat treatment restores the initial hardness of the base material. Boride layers form that are very hard and very resistant with a greater layer density than is the case with conventional hard material films. A disadvantage of this process is that residues of the donor media are left on the material surface and must be removed and subsequently disposed of with extensive effort. To avoid these disadvantages, possibilities are being investigated for working with harmless gaseous donor media. To a great extent this has already been done successfully through an additional plasma support for the boriding of low alloy steels. However in this area, at this point in time the formation of pores was a problem. Moreover, the technology was not suitable for treatment of high alloy steels.

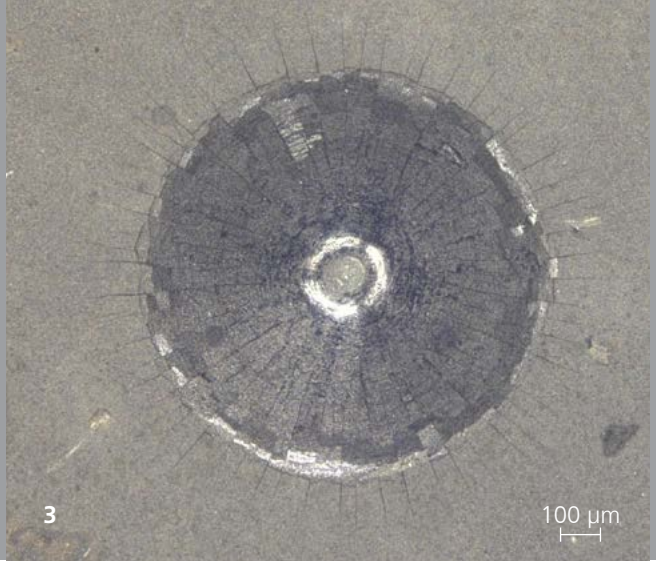
The new boriding process

At the Fraunhofer IST specialists have succeeded in producing virtually pore-free boride films on different high alloy hot-working steels and high-speed steels at temperatures from 700 to 750 °C in a vacuum chamber through a modified process gas implementation and optimized gas distribution. In this process BCl_3 was used as the donor medium. An additional plasma support is not necessary. Another advantage of the new boriding process is that the required use of the donor medium has been reduced by more than half.

The layer properties

With the new process after a process time of just two hours a layer thicknesses of more than 10 µm could be achieved. Depending on the tool steel used and the process parameters the layer hardness's are between 1800 and 2500 HV. In tribometer tests in a so-called ball-target arrangement the layers show excellent friction and wear behavior against steel and aluminum balls. Also, noteworthy is the extremely low adhesion tendency relative to aluminum.

Fraunhofer Institute for Surface Engineering and Thin Films IST | Bienroder Weg 54 E | 38108 Braunschweig | Germany



1 *Boriding layer in high alloy thermal hot-working steel 1.2343.*

2 *Experimental tool for hot forging applications.*

3 *Rockwell impression in a 10 µm thick boride layer.*

Outlook

As part of the IGF project "Use of plasma boriding processes to increase the resilience of forging dies" (IGF 19553 N) currently the use characteristics of the boride layers are being investigated in series forging trials. Additional application tests for forging and casting of aluminum as well as sheet-metal forming of steel and light alloys are in preparation.

The project

The IGF project, IGF 19553 N of the Research Association for Tools and Materials (Forschungsgemeinschaft Werkzeuge und Werkstoffe e. V.) has been funded via the AIF as part of the program for promoting industrial collective research (IGF) from the Federal Ministry for Economic Affairs and Energy based on a resolution of the German Bundestag.

CONTACT

Dipl.-Ing. Martin Weber
Phone +49 531 2155-507
martin.weber@ist.fraunhofer.de