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Plasmaboriding of high-alloyed tool steels – a new approach for wear reduction on highly loaded forming tools

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Boriding of low alloy steels with powder or a paste-like precursor is well understood and has been studied for many years. The process involves boron diffusing into the material surface at temperatures above 750 ° C. Very hard and wear-resistant boride layers with a larger layer thickness are formed compared to conventional hard coatings. A disadvantage of this process is the resulting residues of the precursor on the material surface, which must be laboriously removed and then disposed of. To get around this, gas boriding processes with BCL_3 precursor and additional plasma support were developed. However, the problem here was the formation of pores and the technology was not suitable for the successful treatment of high-alloy steels.
With a new boriding process, it was possible to produce almost non-porous boride layers on various high-alloyed steels at temperatures of 700 - 750 ° C. This could be achieved by changing the process gas composition and changing the gas supply. The use of the BCL_3 precursor could be significantly reduced. With the new process, coating thicknesses between 10 and 20 µm with good adhesion can be achieved after a process time of two hours. Depending on the tool steel used and the process parameters, the layer hardness is between 1800 and 2500 HV. After boriding, the edge zone has a columnar structure which has disappeared after post-hardening of the steels according to the specifications of the material manufacturers. In Chromium-alloyed tool steels a fine-grained edge zone with chrome boride precipitates could be observed. Ball-on disk-tests against steel and aluminum demonstrate a very good friction and wear behavior.

Keywords
plasma diffusion
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high-alloy steel