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UP-SCALING OF PLASMA BORIDING

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Thermochemical heat treatment processes can adapt the surface of steel parts to different stress conditions. Especially the wear resistance of parts in mechanical engineering and automotive industries can be improved by optimizing their surface using heat treatments like plasmanitriding or -carburizing. But in case of combined stress of high abrasive wear, adhesive stressing and very high shearing forces, most kind of economical surface modification will overload. This was observed in automotive helical gear wheels and in plastic industry on barrel extruders. In particular the boriding process renders the possibility of producing layers with excellent properties under these stressing conditions. But in industrial scale of plasma diffusion treatment only plasma nitriding and carburizing are widely applied, plasma boriding, however has not achieved the necessary market maturity until now, even though plasma boriding of steel leads to the same excellent wear protection as harmful powder or paste boriding. A mass production or a treatment of large scale work pieces wasn't successfully done in plasma boriding till now. The formation of pores during the plasma boriding with BCl3 is the problem that has to be solved. To overcome the difficulties in plasma boriding it is necessary to optimize the treatment gas distribution in the process chamber. Successful experiments about the up-scaling of the plasma boriding to an industrial size were carried out at the IOT after computer simulation of thermochemical reaction and fluid dynamic behaviour. It was found that the residence time of the treatment gas correlates with the formation of pores in the surface. A new gasinlet and outlet system was designed and tested by implementation to existing industrial size plasmadiffusion equipment from Sulzer Metaplas. After first promising results, a complete new furnace was designed and built with different possibilities of MFC-controlled gasinlet ports at different positions of the chamber. This paper reports on the progress made recently in up-scaling the plasma boriding, especially in pore formation and layer uniformity by the new furnace layout and the new gas distribution system. The structure analysis was done by XRD diffraction and SEM, the component distribution was determined by GDOS and the mechanical properties as hardness and wear resistance by universal hardness and pin on disc test. Results will be presented in detail on the conference.

Keywords
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