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Comparison of plasma nitrided and oxinitrided austenitic stainless steel concerning corrosion and wear behavior

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Plasma diffusion treatment is a competitive method to improve mechanical and tribological properties of austenitic stainless steel. According to the treatment gas, the following procedures are distinguished: Plasma nitriding, nitrocarburizing and oxinitriding. Thus, material properties of austenitic stainless steel such as hardness, wear resistance as well as corrosion resistance can be modified and customized according to requirements. One limiting factor for using plasma nitriding is the loss of corrosion resistance and the simultaneous increase in hardness. Previous studies have shown that lowered pulse duration and a higher pulse pause can counteract this process as well as plasma nitriding at lower treatment temperature. Obtaining a further improvement in nitriding results of austenitic stainless steel by activating of the surface the effect of oxygen in a plasma diffusion treatment was observed. Furthermore the influence of oxidizing before and after the nitriding process was compared to the results of the oxinitriding treatment. After an evaluation of these three methods the optimization of the plasma nitriding treatment was made by varying treatment parameters such as treatment duration, temperature and pulse ratio as well as gas mixture. For characterizing nitriding/oxinitriding results, hardness profiles were recorded as well as nitrogen/oxygen depth profiles by glow discharge optical spectroscopy (GDOS). The tribological properties of nitrided/oxinitrided samples were determined by pin on disc test. Potentiodynamic polarization tests were applied to evaluate the corrosion behavior of treated samples. The microstructure and phase composition of the layers were investigated by using light microscopy and X-ray diffraction. The aim of this study is to adapt the preliminary findings of the nitriding to the oxinitriding process to produce a nitrided layer which is characterized by a high hardness associated with an enhanced wear resistance with at least a similar corrosion resistance.

Keywords

plasma nitriding/oxinitriding
austenitic stainless steel
corrosion resistance