PO2078

A two-stage process for plasma nitriding with an active screen

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The use of two-component atmosphere of dissociated or diluted with N_2/H_2 gas ammonia was first proposed by Floe as a two-stage process. The method allowed producing of nitriding case with required hardness in the first stage and acceptable case depth in the second stage. The structure and the thickness of the compound layer can be effectively controlled in the Floe process. The active screen plasma nitriding (ASPN) is a novel plasma assisted nitriding technique with a high application potential. The main advantages of the ASPN over a conventional plasma process are caused by the replacement of the glow discharge from the components to a separate metal screen (active screen, AS) surrounding the entire workload. During the nitriding process the active screen plays a twofold role - it generates a mixture of active species required for the nitriding process and it radiates the heat, produced by the plasma discharge, resulting in a uniform temperature distribution over the workload parts. A weak cathodic potential (bias) applied to the treated parts plays a decisive role in the nitriding. In the present work a two-stage technique was applied in the ASPN to obtain a better control on the nitriding process and to meet the treatment requirements for a wide range of the steel types, different load size and workpiece geometry. A nitriding temperature range of 400-450 °C for 2 h and 550-570 °C for 4 h was chosen for the first and the second stage, respectively. The nitriding potential of the N_2-H_2 plasma was varied specific to each stage by a combination of properly chosen N_2 to H_2 gas ratio and sufficient level of the bias power applied to the workload. Besides the process temperature control the AS power showed an additional influence on the kinetics of the chemical reactions in plasma, resulting in further change of the nitriding potential.A response of the nitriding results of the alloyed steels on the variation of the process conditions in each stage was presented and discussed together with the plasma diagnostic results.

Keywords
active screen plasma nitriding
two-stage process
OES
IR laser absorption spectroscopy