OR1407

Investigations on the active screen plasma nitriding process

Kristian Börner[1], Igor Burlacov[1], Heinz-Joachim Spies[1], Horst Biermann[1], Stephan Hamann[2], Jürgen Röpcke[2]

[1]Institute of Materials Engineering, Freiberg, Germany [2]INP Greifswald, Greifswald, Germany

boerner1@mailserver.tu-freiberg.de

This study presents the mechanism of nitrogen transfer in a large scale active screen plasma nitriding (ASPN) unit. The active screen provides a homogeneous temperature distribution within the workload as well as an arcing tendency is reduced, since the plasma is moved from the treated work pieces to the active screen. In order to study the mechanisms in detail, plasma diagnostics is necessary.
The applied diagnostic methods for analyses of the excited process gas synthesised by the active screen include mass spectrometry and infrared diode laser spectroscopy (TDLAS). Together with a metallurgical characterisation of nitrided steels a better understanding of the chemical phenomena in the N_2-H_2 plasmas is achieved. Various N_2/H_2 gas mixtures and variable bias activation powers at the pressure of 200 Pa were investigated. The main active species governing the nitriding process i.e. N, N_2, NH or NH_x in excited or ionized form were analysed. It was found that even during heating up in nitrogen free process gas exited nitrogen (atomic or molecular) releases from the active screen. Infrared diode laser spectroscopy has been used as a diagnostic methode to measure the concentrations of the stable NH_3 molecules downstream the plasma source. The ammonia production turns out to depend on the mixtures of N_2-H_2 and the current input of the bias activation. The results are discussed with the plasma parameters measured by the electrostatic probe. Thus, a contribution to the interpretation of the mass transfer in ASPN processes has been realised.

Keywords
Active screen plasma nitriding
mass transfer mechanism
mass spectrometry
Absorption spectroscopy