Influence of Reduced Current Density on PIII Nitriding of Austenitic Stainless Steel and CoCr Alloys

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Abstract

The formation of expanded austenite in austenitic stainless and CoCr alloys is a well established fact while the underlying mechanisms are still contended. When inserting nitrogen by plasma immersion ion implantation (PIII), additional auxiliary heating allows a reduction of the average current density by either reducing the voltage or the pulse repetition frequency. The influence of the ion bombardment – additional to the nitrogen atoms arriving at the surface from immersing in the plasma – on the nitrogen uptake and diffusion depends on the alloy: CoCr displays a continuous increase of the layer thickness with ion fluence at nearly identical near surface concentrations and concentration gradients. In contrast, in austenitic stainless steel, a threshold in ion flux has to be overcome to remove the surface oxide barrier before nitriding is possible. At the same time, the nitrogen surface concentration increases with increasing layer thickness at higher ion fluences. Regarding the formation of expanded austenite, a higher ion flux leads to a reduction of the peak widths for the expanded phase in the corresponding x-ray diffraction patterns, which cannot be explained from a change in the nitrogen depth profile gradient.

Keywords: ion implantation, surface adsorption

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