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The effect of plasma nitriding on the interfacial contact resistance and the corrosion resistance of austenitic stainless steel

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Austenitic stainless steel has a wide range of applications. It is very versatile because of its high resistance in corrosive mediums, depending on the amount of alloys. A promising application field for austenitic stainless steel arises from fuel cell technology. It could be the new material for bipolar plates in proton exchange membrane fuel cells (PEMFC) as a substitute for conventionally used graphite electrodes. In relation to graphite, corrosion-resistant stainless steel has the substantial advantage of higher electrical conductivity. The comparably high forming capability of stainless steel makes the manufacture of bipolar plates suitable for mass production. While plasma diffusion treatment improves the electrical properties of austenitic stainless steel the corrosion resistance should not deteriorate because of the acid environment prevailing in a PEMFC.

The purpose of this study is to compare the different processes such as plasma nitriding, nitrocarburizing and oxinitriding regarding their influence on the interfacial contact resistance (ICR) and the corrosion resistance of 304L stainless steel treated at various parameters. Current investigations show, that the electrical conductivity of stainless steel increases significantly at low temperature plasma nitriding. However, when a high amount of oxygen was added, the ICR gets substantially worse, but through a drop in treatment temperature of 350°C the ICR did not deteriorate any further. The reduction of the oxygen content leads to a decreasing interfacial contact resistance below the ICR of untreated 304L stainless steel. Corrosion behaviors of the nitrided samples were evaluated by potentiodynamic polarization tests in aerated 80°C heated H_2SO_4. In initial results an enhancement of corrosion resistance could ascertained on low temperature oxinitrided samples as compared with untreated ones. The secondary ion mass spectroscopy (SIMS) was used to determine the thickness of the passive layer on the top of the nitrided samples.

Keywords
Plasma nitriding
Nitrocarburizing
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Corrosion resistance