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Combined low-pressure plasma surface modification of thin austenitic stainless steel sheets for bipolar plates

Krasimir Nikolov, Katharina Bunk, Antje Jung, Peter Kaestner, Claus-Peter Klages

TU Braunschweig, Braunschweig, Germany

k.nikolov@tu-braunschweig.de

Bipolar plates manufactured from surface-modified austenitic stainless steel sheets are of great interest in the field of proton-exchange membrane fuel cells, especially for automotive applications. In view of the requirement of cost-effective continuous processes, the strip hollow-cathode method was developed recently for plasma thermochemical treatment and a short-time plasma nitriding was investigated in order to improve the surface electrical properties, as reported earlier. However, concerning the severe requirements dictated by the fuel cell application, a sufficient corrosion resistance has not been ensured yet. Moreover, despite the significant reduction of the interfacial contact resistance, its stability after a simulated electrochemical polarisation is questionable.
Aiming at the achievement of superior surface characteristics of austenitic stainless steels with respect to their use for bipolar plates, a novel combined plasma-based surface modification has now been studied, based on several consecutive processes including plasma nitriding as a final step. Within the present work steel sheets EN1.4301 with a thickness of 0.1mm were differently treated by means of the novel combined surface modification. The surfaces were analysed by glow-discharge optical emission spectroscopy, X-ray photoelectron spectroscopy and X-ray diffraction. Further investigations were performed in order to determine the influence of the treatment on the electrical conductivity and corrosion resistance of the stainless steel surfaces.

Keywords
Combined plasma surface modification
Bipolar plate
Interfacial contact resistance
Corrosion resistance