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ATMOSPHERIC PLASMA TREATMENT OF FUEL CELL BIPOLAR PLATES

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Proton exchange membrane fuel cells, also known as polymer electrolyte membrane fuel cells (PEMFC), are a type of fuel cell being developed for transport as well as for stationary and portable fuel cell applications. Their distinguishing features include lower temperature/pressure ranges (50 to 100 °C) and a special polymer electrolyte membrane. In the majority of cases hydrogen is used as its fuel and oxygen (usually from air) as its oxidant. The reaction product in this process is water, which needs to be dissipated out of the fuel cell effectively. It turns out that the transport of this water in the bipolar plate is crucial. The wettability of the bipolar plate surface is therefore one determining factor for the performance of the fuel cell. By surface treatment of the bipolar plates the wettability can be adjusted in a very wide range (from hydrophilic to hydrophobic). An industrial scalable method for the surface modification is the atmospheric plasma treatment. The plasma treatment can at the same time be used to activate the surface (by chemical terminating the surface) as well as to etch the surface (increasing the roughness). Both processes influence the contact angle of water on the bipolar plate surface.
Bipolar plates made of 82% graphite and carbon black and 18% of polypropylene were treated by a CYRANNUS I - 6” microwave source used in a remote plasma process by variation of the process parameters. The influence of gas composition, gas pressure and position of the substrate in the effluent are investigated in particular. In addition the influence of the plasma treatment on the contact resistance of the bipolar plates is examined. Surface analysis (Raman and FTIR Spectroscopy) and imaging methods (SEM, AFM) are used to investigate the effect of the plasma on the surface.

Keywords
atmospheric plasma
wettability
bipolar plates