Abstract #1713, 224th ECS Meeting, © 2013 The Electrochemical Society

# CORROSION BEHAVIOR OF BIPOLAR PLATE MATERIALS IN ACID MEDIA

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## Abstract

The bipolar plate is a multi-functional component within a proton exchange membrane fuel cells (PEMFC) stack. Beyond electrical conductivity, gas impermeability, mechanical and chemical stability, the high corrosion resistance is required for bipolar plates, which operate in constant contact with the acidic water under high temperature (up to 120$^{o}$C) and high pressure of oxygen and hydrogen gases.

Various materials have been studied for bipolar plate in severe operating conditions inside PEMFC containing proton ($H^{+}$), sulfate ($SO_4^{2-}$) and fluoride ($F^{-}$) ion. In this paper, the corrosion behavior of four metal based materials (SU304 stainless steel, pure nickel (Ni), carbon steel and Ni coated carbon steel) was studied the acidic ($H_2SO_4$) solutions at pH 2-5. The potentiodynamic polarization and electrochemical impedance spectroscopy (EIS) have been used to determine the corrosion rate of these materials. The results showed that corrosion rate in acidic media decreases with increasing the pH. The corrosion rate of pure nickel is lowest and of carbon steel is highest. The conditions of Ni electroplating were optimized to enhance anti-corrosion performance of low cost carbon-steel based materials to meet requirements of bipolar plates for PEMFC. The structure and morphology of Ni coatings were studied by X-ray fluorescence (XRF), X-ray diffraction (XRD) and scanning electron microscopy (SEM).

*Keywords: bipolar plate, corrosion, electroplating, nickel, PEMFC.*