

NEW TYPE OF MEMBRANE ELECTRODE ASSEMBLY BASED ON NAFION MEMBRANE AND POLYPYRROLE

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With intensive development of low temperature fuel cell of type PEMFC there is an effort for minimization of catalyst load and for maximal utilisation of fuel. First problem is connected mainly with the catalyst itself and catalyst support material. Losses of the fuel by its permeation through the solid polymer membrane can be minimised by the modification of the membrane material and/or by the modification of membrane surface by an additional layer. In a modern PEMFC construction are electrodes located directly on membrane surface. This composite so-called membrane electrode assembly (MEA) represents the crucial component of PEMFC. As polymer membrane material is widely used the Nafion (DuPont). In a typical present PEMFC electrode carbon is used as a support. Teflon in a mixture with Nafion serves as a binder. Conducting polymers (CP) represent an alternative to this electrode construction. Polyaniline and polypyrrole (PPy) are the materials most often referred to in the literature. Main advantage of conducting polymers consists in fact, that they pose good electronic parallel to ionic conductivity and according to the literature they deteriorate membrane permeability for the fuel. Catalytic activity of CP/Pt composite was intensively studied in the literature in the past. Nowadays the main problem presents CP fixation on the membrane surface providing good adherence and proton contact. Due to the nature of CP material its synthesis directly on the membrane surface seems to be more appropriate than classical fixation techniques like e.g. hot-pressing.

The aim of present work was to prepare of PPy-Nafion-PPy composite, i.e. membrane electrolyte covered on the both surfaces by the PPy film. Since PEM is not an electron conductive material it is not possible to prepare PPy film by direct electrosynthesis. Therefore PPy was synthesised by oxidising of Py diffusing through the Nafion film by the peroxodisuphate directly in the moment it has reached the outer membrane surface. The process of PPy layer formation is indicated by the gradual change of Nafion membrane colour from colourless to black characteristic for PPy. The UV-Vis spectroscopy was used to control in-situ PPy film grow at this stage. Identical procedure was used in order to prepare PPy film on the opposite surface of the membrane. Low permeability of PPy surface film to monomer unit has been proved. Kinetic of polymerisation of the film on the opposite membrane surface was thus deteriorated seriously and even polymerisation times as long as 17 hours were not sufficient to produce film of sufficient thickness. At this stage the advantage of electrochemical activity of PPy has been taken and necessary portion of the PPy was polymerised electrochemically on the top of chemically presynthesised film. In order to investigate morphology of prepared composite the scanning electron microscopy (SEM) was used. It has confirmed that the PPy film was formed exclusively on the Nafion surface.

The present work shows relatively simple preparation of PPy-Nafion-PPy composite with good mechanical properties and sufficient electrochemical activity. Prepared composite can serve as base for the further development of PEMFC MEA based on CP.

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