Technical University of Denmark



Methods for HT-PEM FC electrodes preparation

Vassiliev, Anton; Andersen, Kjeld Bøhm; Martin, S.; Cleemann, Lars Nilausen; Jensen, Jens Oluf

Publication date: 2014

Link back to DTU Orbit

Citation (APA): Vassiliev, A., Andersen, K. B., Martin, S., Cleemann, L. N., & Jensen, J. O. (2014). Methods for HT-PEM FC electrodes preparation. Poster session presented at CARISMA 2014 Conference, Cape Town, South Africa.

DTU Library Technical Information Center of Denmark

General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

• Users may download and print one copy of any publication from the public portal for the purpose of private study or research.

- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

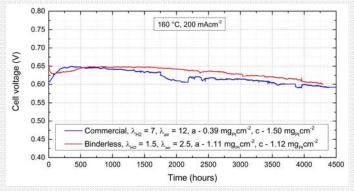
Methods for HT-PEMFC electrode preparation and their influence on MEA activity

A. Vassiliev, K.B. Andersen, S. Martin, L.N. Cleemann and J.O. Jensen

Proton Conductors Group, Department of Energy Conversion and Storage, Technical University of Denmark

Catalyst layers made by spraying or tape casting have been prepared and evaluated on the cathode side of an HT-PEMFC. For spraying the catalyst inks were prepared by ultrasonic treatment and for tape casting the slurries were prepared by planetary milling. Different solvents and various amounts of binder have been tried to find optimum compositions. Additions of more than 20 wt% binder content greatly improves handling of the electrodes without sacrificing MEA performance.

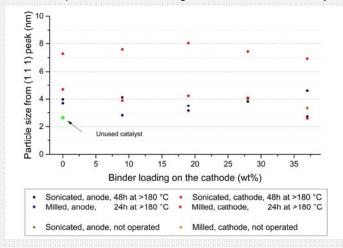
Recently it has been shown that a MEA with catalyst layers made from an ink containing only the Pt/C catalyst in ethanol exhibits similar performance with a MEA prepared by standard methods [1].



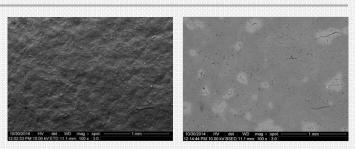
To obtain better handling of the final electrodes and improve the porosity a binder with decomposition temperature suitable for *in-situ* removal was chosen. Several solvents have been tried to find an optimum ink formulation and 2-butanone proved to be the best candidate. Ink formulations were made with ultrasonic treatment or by planetary milling. Spraying and tape casting were investigated as catalyst deposition methods.

Solvent	Ethanol	Acetone	2-butanone	1-propanol	2-propanol
Binder	Not dissolved	Dissolved	Dissolved	Not measured	Not measured
Catalyst	Combustion	No reaction	No reaction	Peroxide formation	Peroxide formation

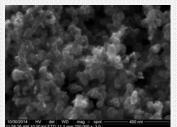
Particle size analysis show no significant influence of preparation methods on the growth of Pt catalyst particles. Prolonged operation at elevated temperature showed a stronger effect for the cathode catalyst.



 S. Martin, Q. Li, T. Steenberg and J.O. Jensen, Binderless Electrodes for High-Temperature Polymer Electrolyte Membrane Fuel Cells, Journal of Power Sources, 2014, 272, p. 559.



Secondary and backscattered electron images of a tape cast electrode with Pt/C catalyst and 28 wt% binder content. The structure of sprayed electrodes is comparable (not shown). Cracks appearing with increasing binder content is similar to conventional PBI-containing electrodes [2].





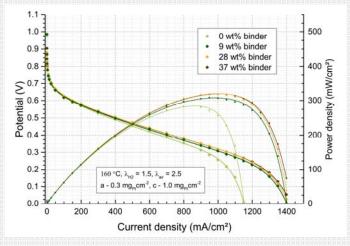
CARISMA2014

CAPE TOWN, SOUTH AFRICA | 2014

SEM picture of an electrode with Pt/C and 28 wt% binder content. The individual Pt particles are not covered with the binder.

Cross section image of a MEA with Pt/C and 28 wt% binder content on the cathode (center) and commercial anode (left). Electrode structures are comparable.

Polarisation and power curves of MEAs with increasing binder content on the cathode side show a positive effect on the cell performance in high current density range. This can be due to increased triple phase boundary obtained by removal of the binder.



[2] J. Lobato et al., Study of the influence of the amount of $PBI-H_3PO_4$ in the catalytic layer of a high temperature PEMFC, Int. Journal of Hydrogen Energy, 2010, 35, p. 1347.