Wetting properties of Proton Exchange Membrane Fuel Cell electrodes

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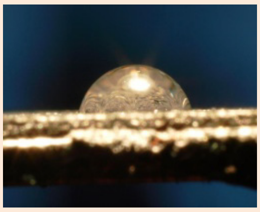
IRD Fuel Cell Technology

Introduction:

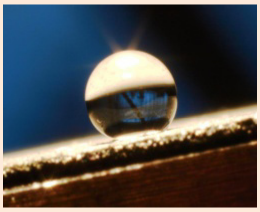
As one of the most promising future energy provider, Proton Exchange Membrane Fuel Cells (PEMFCs) berry the merit of renewability, efficiency and cleanness [1, 2]. Durability issue of PEMFCs is nowadays well recognized no less important as exploring alternative cheaper material or increasing cell efficiency [3]. Degradation of a cell can results from different factors; one of the important failure modes is the limitation of mass transport due to water management in the gas channel [4]. Therefore, wetting property of the electrode is a major factor influencing the transport and accumulation of water.

GDL 30% ETFE



0 ion.

30% ion.



GDL 30% ETFE 10º

0 ion. 40º

CV treated 30% ion. 40º

Experimental:

Fig. 1 Autoclave

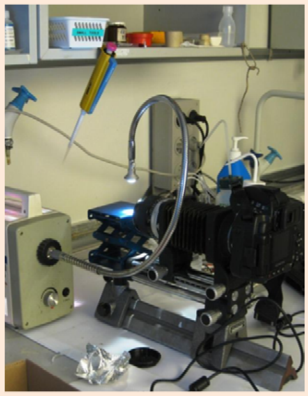


Fig. 2 Contact angle meas.

Gas diffusion layer (carbon paper), or electrodes were chemically treated with 20% hydrogen peroxide at 80 ºC in auto clave (fig. 1) or electrochemically treated with potential cycles between hydrogen and oxygen evolution.

Contact angle measure was achieved by the setup shown in the figure 2. Each time, 5 µL distilled water was carefully applied on the surface to be analysed. Then a snapshot was then taken for record.

Results & Discussion:

Combine the knowledge of contact angle (fig. 3) and weight loss of GDL (fig. 4) after chemical treatment, it suggests that top micro-layer surface of GDL is most responsible for wetting properties. After top ETFE layer was chemically oxidized by H_2O_2 attaching, it depredates and probably is washed off by the solution, a new ETFE layer was formed, therefore, there is not a very big drop in contact angle and tend to be stabilized.

As shown in fig. 5, 30% ionomer electrode shows biggest drop in contact angle, furthermore, normal, reducing and advancing contact angle turn out to be very close values, which also reflect increasing affinity between electrode surface and water (increasing hydrophilicity), and less influence from gravity. Area density normalized with catalyst loading was also studied (fig. 6). Between 5 and 15% area density lost after the treatment. Among those, 30% electrode again, shows biggest drop.

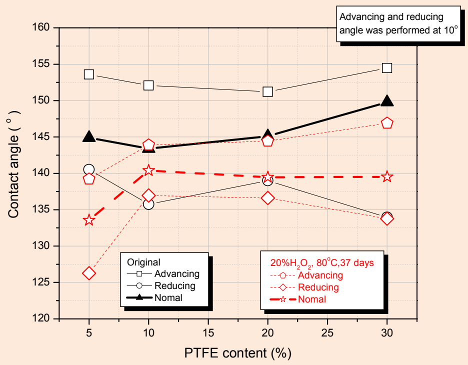


Fig. 3. Contact angles for GDLs

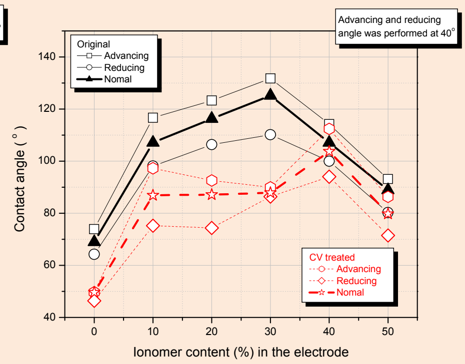


Fig. 5. Contact angle for electrodes

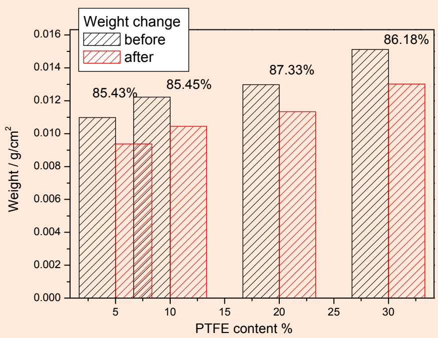


Fig. 4. Weight loss change of GDL

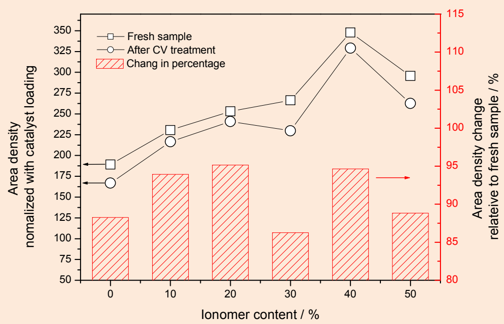


Fig. 6. Area density of the electrodes and percentage change

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