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Separate measurements of current under the channels and the land in a PEM Fuel Cell with an interdigitated flow field

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Proton exchange membrane (PEM) fuel cell is regarded as one of the most promising power systems for the future vehicles. When supplied with air and hydrogen, PEM fuel cells show various advantages, such as quick start-up, high efficiency and pollution-free. It is well known that the current distribution in a PEM fuel cell is not uniform. The measurement of local current density distribution is essential to PEM fuel cells design optimizations.

In this study, an in-house partial-catalyzed membrane electrode assembly (MEA) at cathode side is fabricated. Fig.1 shows the schematic of partial-catalyzed MEA. Separate in situ measurements of current densities under the inlet channel, the land and the outlet channel in a PEM fuel cell with a single interdigitated flow field are conducted for different cathode air flow rates and different cathode back pressures.

Fig. 2 shows the current densities under the inlet channel, the land and the outlet channel. In the lower current density region, the current density under the land is higher than that under the inlet channel. However, in the higher current density region, the current density under the inlet channel is higher than that under the land. The results have both similarities and differences with those for parallel flow field and serpentine flow field[1,2]. One significant difference is the large difference between the inlet and outlet channels.

Fig. 3 compares the maximum power densities under the channels and the land for different cathode flow rates. The maximum power density curves under the inlet channel and the land almost overlap with each other, and both of them are higher than that under the outlet channel.

Fig. 4 compares the maximum power densities under the channels and the land for different cathode back pressures. It is shown that the maximum power density under the inlet channel is the highest, and the maximum power density under the land is close to that under the inlet channel. In addition, there is significant difference in maximum power density difference between the inlet and outlet channels.

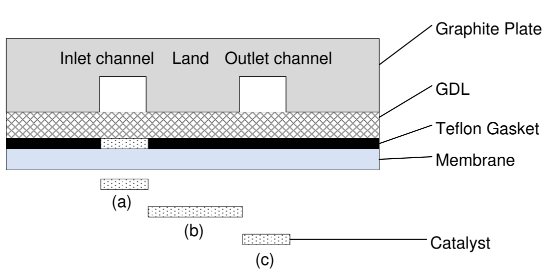

Fig. 1 Schematic of cathode partial MEA under the channels and the land: (a) MEA catalyzed under the inlet channel only; (b) MEA catalyzed under the land only; (c) MEA catalyzed under the outlet channel only.

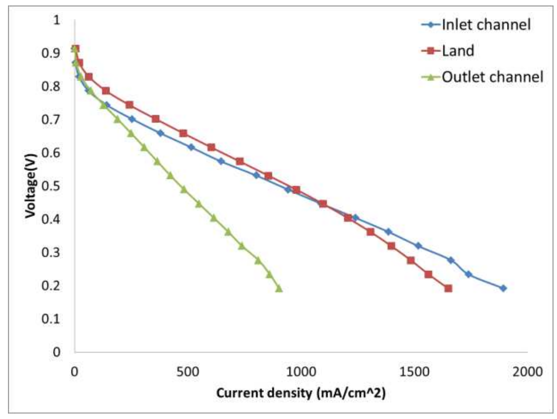

Fig. 2 Polarization curves comparisons under the channels and the land: anode and cathode are fully humidified, cell temperature= 70℃ ; hydrogen flow rate=1000 sccm, Air flow rate=1500 sccm; ambient pressure at both anode and cathode sides.

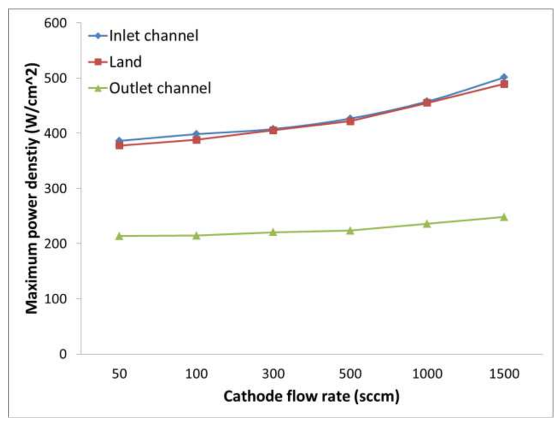

Fig.3 Maximum power density comparisons under the channels and the land at different cathode flow rate: anode and cathode are fully humidified, cell temperature= 70℃ ; hydrogen flow rate=1000 sccm; ambient pressure at both anode and cathode sides.

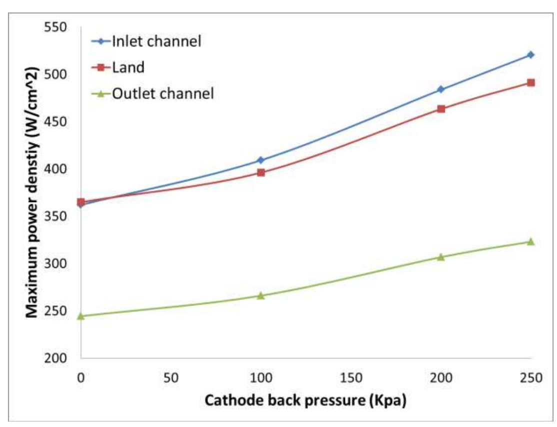

Fig. 4 Maximum power density comparisons under the channels and the land at different cathode back pressure: anode and cathode are fully humidified, cell temperature= 70℃ ; hydrogen flow rate=500 sccm, air flow rate=500 sccm; ambient pressure at anode side.

Reference

1. L. Wang and H. Liu, J Power Sources, **180**, 365 (2008).
2. A. Higier and H. Liu, J Power Sources, **193**, 639 (2009).