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Supporting Information

Excellent performance of Pt-free cathode in alkaline direct methanol fuel cell at Room temperature

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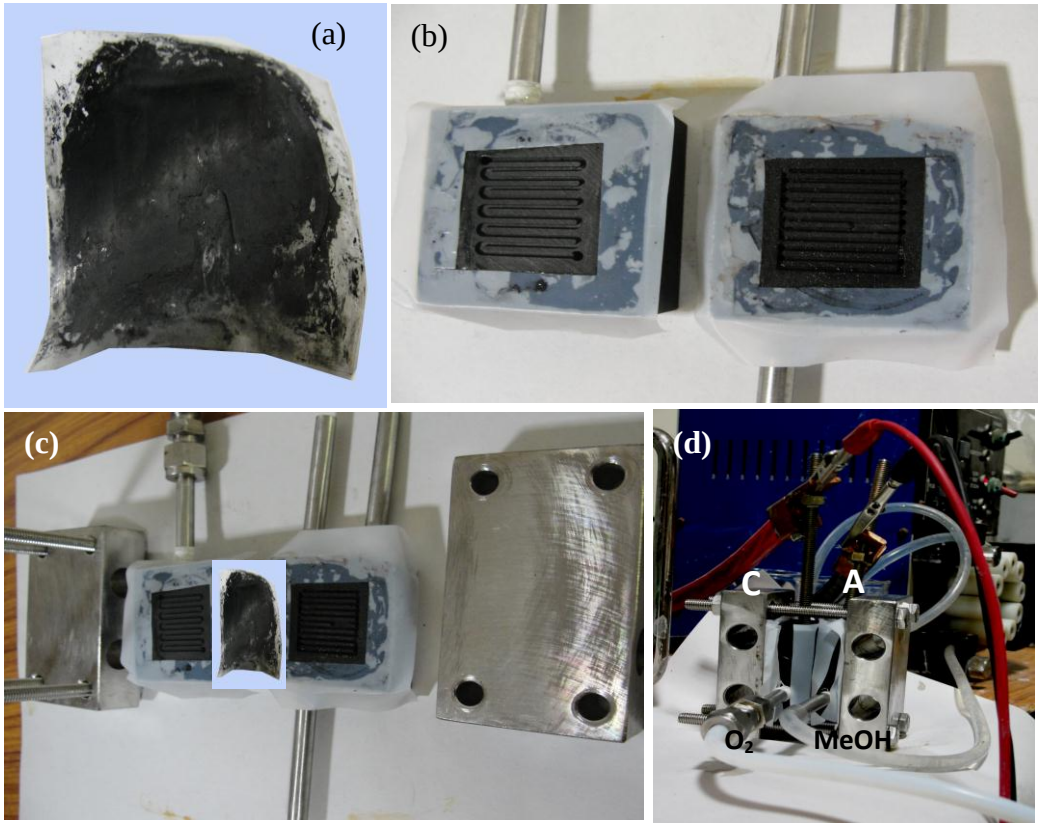

Fig. S1 (a) Digital photograph of Nafion® membrane with the catalyst layer. (b) The home-made bipolar carbon plates (covered with Teflon spacer) with serpentine and parallel flow channels. Stainless steel flow tubes are connected for fuel/oxygen flow. (c) The different components of fuel cell device: stainless-steel plates, bipolar plates with Teflon spacer and

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MEA. (d) The compacted fuel cell device. The different fluid flow path for oxygen (O_2) and methanol (MeOH) is shown. Anode (A) and cathode (C) compartments are highlighted.

Mechanism of cell operation in Nafion® based ADMFC:

It has been suggested[1,2] that the proton conducting Nafion® 117 can be converted to Na^+ ion conductor by simply treated with strong alkali like NaOH as has been adopted here. The electrolytic conduction occurs in this membrane via the transport of Na^+ ions from anode to cathode where the produced hydroxide ion from the reduction of oxygen readily reacts with Na^+ ion to maintain the electroneutrality as well as completes the electronic circuit. In addition, water is transported along with Na^+ ion from anode to cathode. The disadvantage associated with this process is that the ionic conductivity of this membrane would be lower than that of proton form of Nafion®. Hence, there will be a compromise between ionic conductivity and electrocatalytic activity at the electrodes.[1]

References:

1. E. H. Yu, K. Scott and R. W. Reeve, *J. Appl. Electrochem.*, 2006, **36**, 25.
2. L. An and T. S. Zhao, *Energy Environ. Sci.*, 2011, **4**, 2213.