

## Supporting Information

### 3D Pd/Co core-shell nanoneedle arrays as high performance cathode catalyst layer for AAEMFCs

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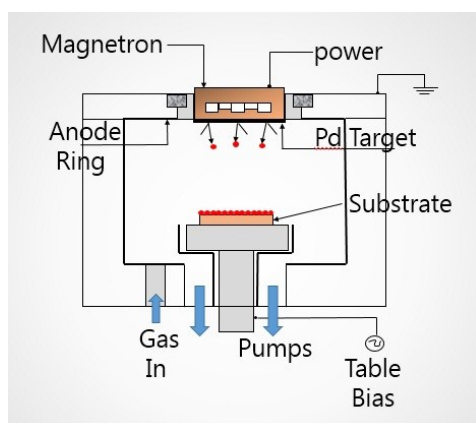


Fig. S1 The setup arrangement of sputtering deposition.

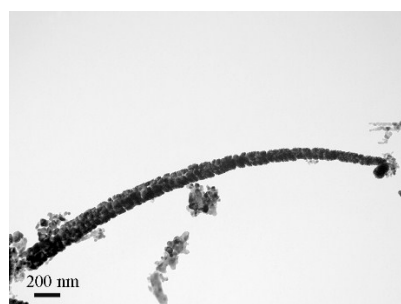


Fig. S2 low magnification TEM image of Pd/Co nanoneedle.

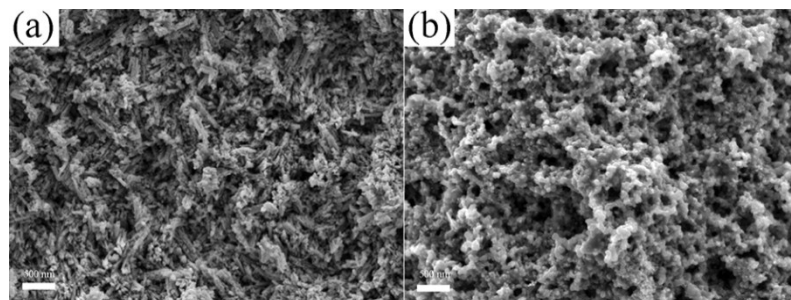


Fig. S3 The SEM images of the prepared catalyst layers coated on the membrane: (a) Pd/Co nanoneedle arrays, (b) conventional Pt/C catalyst layer.

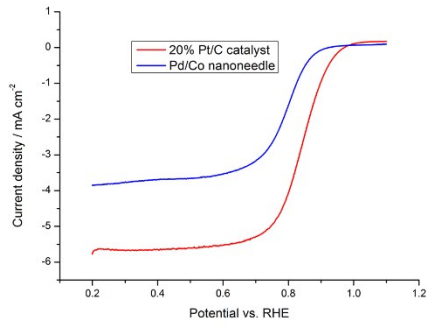


Fig. S4 ORR polarization curves for Pd/Co nanoneedle and 20% Pt/C catalyst. The measurements were performed in 1.0 M O<sub>2</sub>-saturated KOH solution. Scan rate: 10 mV s<sup>-1</sup>. Rotational speed: 1600 rpm.