SUPPORTING INFORMATION

Efficient Chitosan/Nitrogen-doped Reduced Graphene Oxide Composite Membranes for Direct Alkaline Ethanol Fuel Cells

Seldestina Gorgieva¹, Azra Osmić², Silvo Hribernik¹, Mojca Božič³, Jurij Svete⁵, Viktor Hacker⁴, Sigrid Wolf⁴ and Boštjan Genorio⁵*

¹Faculty of Mechanical Engineering, University of Maribor, Smetanova 17, 2000 Maribor, Slovenia
²Faculty of Electrical Engineering and Computer Science, University of Maribor, Koroška cesta 46, 2000 Maribor, Slovenia
³Dravske elektrarne Maribor d. o. o., Obrežna ulica 170, 2000 Maribor, Slovenia
⁴Graz University of Technology, Institute of Chemical Engineering and Environmental Technology, Stremayrgasse 9, 8010 Graz, Austria
⁵University of Ljubljana, Faculty of Chemistry and Chemical Technology, Večna pot 113, SI-1000 Ljubljana, Slovenia

Corresponding author

Assist. Prof. Dr. Bostjan Genorio

University of Ljubljana, Faculty of Chemistry and Chemical Technology
Večna pot 113, SI-1000 Ljubljana, Slovenia

Tel.: +386 1 479 8586

E-mail: bostjan.genorio@fkkt.uni-lj.si
Figure S1. SEM image of Polyenaminone 4ca[13].
Figure S2. Raman spectra of a) N-rGO, b) N-rGONRs, and c) N-pEAO.
Figure S3. CHN elemental analysis of N-rGO, N-rGONRs, and N-pEAO.
Figure S4. Typical DEAFC discharged cell voltage and power density of CS/N-rGONRs (0.07%) as a function of temperature in a) 1 M EtOH/1 M KOH and b) 3M EtOH / 5M KOH.
Table S1. $P_{\text{max}}$ and related current density of CS membranes at 57 °C.

|                | $P_{\text{max}}$ 0.01 % [mWcm$^{-2}$] | $P_{\text{max}}$ 0.04 % [mWcm$^{-2}$] | $P_{\text{max}}$ 0.07 % [mWcm$^{-2}$] |
|----------------|---------------------------------------|---------------------------------------|---------------------------------------|
|                | 1 M EtOH/1 M KOH                      | 1 M EtOH/1 M KOH                      | 1 M EtOH/1 M KOH                      |
| CS/N-rGO       | 3.4 (9.69 mAc$m^{-2}$)                | 5.6 (23.01 mAc$m^{-2}$)               | 12.2 (62.81 mAc$m^{-2}$)              |
| CS/N-RGONRs    | 10.7 (56.13 mAc$m^{-2}$)              | 10.9 (56.18 mAc$m^{-2}$)              | 18.0 (93.75 mAc$m^{-2}$)              |
| CS/N-pEAO      | 7.4 (38.99 mAc$m^{-2}$)               | 10.5 (56.14 mAc$m^{-2}$)              | 12.1 (64.65 mAc$m^{-2}$)              |
|                | 3 M EtOH/5 M KOH                      | 3 M EtOH/5 M KOH                      | 3 M EtOH/5 M KOH                      |
| CS/N-rGONRs    | 28.9 (152.42 mAc$m^{-2}$)             | 22.9 (111.22 mAc$m^{-2}$)             | 34.5 (152.54 mAc$m^{-2}$)             |
| CS/N-pEAO      | 20.5 (136.34 mAc$m^{-2}$)             | 24.2 (152.22 mAc$m^{-2}$)             | 21.8 (133.67 mAc$m^{-2}$)             |