Supporting Information for:

Amine Functionalized Polymer Membrane for

Electrochemical Reduction of CO₂ to Hydrocarbons

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(PEI)

(PVA)

(GA)

+ KOH

PEI/PVA

〰〰〰 **PVA chains**   〰〰〰 **Cross linking chains**   ----- **Poly vinyl chains**

Supplementary Figure S1: Synthesis Method for PEI/PVA

Supplementary Figure S2: Synthesis Method for QPEI/PVA

Evaluation of the product

The standard gas mixes of H_2, CO, CH_4, C_2H_4, C_2H_6, and CO_2 with varying concentrations were purchased from Ultra-pure Gases, India. These cylinders had a volume of 0.5 liters and were pressurized to 20 kg•cm^{-2}. These mixtures were used for the detection and calibration of gaseous samples (Supplementary Table S1). CO_2 has been taken as a percentage level due to the fact that the gas product stream contains a large amount of CO_2, and it does not impact any of the other gaseous peaks except for CO_2 while doing an analysis of gaseous compounds. Merck was the supplier for all the GC grade alcohols (methanol, ethanol, propanol, and butanol), as well as formic acid and formaldehyde. All the samples were utilised without any additional purification steps being taken, unless otherwise specified. In order to facilitate the injection of samples, gas and liquid syringes were obtained from Hamilton. The gas chromatograph was used to conduct an analysis on the products that were collected following the $ERCO_2$ process. In the case of gas sample studies, the samples were run through a Carbosieve S-II (3.05 m, 1/8 in., 2.1 mm) column, which was linked in series with a methanizer, a flame ionisation detector (FID) and a thermal conductivity detector (TCD). TCD was used to detect the gases H_2 and CO_2. however, FID was used to identify CO (after going through the methanizer) along with hydrocarbons such as CH_4, C_2H_4, and C_2H_6. While hydrogen and oxygen were employed to ignite the flame, argon was utilised in the process as the mobile phase (carrier gas). The presence of flame is necessary for the proper operation of a flame ionisation detector. In the instance of liquid analysis, samples were analysed by running them through a Porapak Q (SS column of 1/8" OD x 2 m, 80/100 mesh) column that was linked to FID. This allowed for the identification of alcohols (C1-C4). If liquid product analysis was performed, hydrogen was utilised both as a carrier gas and for flame ignition.

Supplementary Table S1: Standard samples for the calibration purpose in GC.

Standard gas mixtures				
Gas (amount)	1	2	3	4
H_2 (%)	1	5	10	15
CH_4 (ppm)	10	50	500	1000
CO (ppm)	10	50	500	1000
C_2H_4 (ppm)	10	50	500	1000
C_2H_6 (ppm)	10	50	500	1000
CO_2 (balance)	99	95	90	85
Standard liquid sample				
Methanol (ppm)	50	100	500	1000
Ethanol (ppm)	50	100	500	1000
Propanol (ppm)	50	100	500	1000
Butanol (ppm)	50	100	500	1000