Supplementary Information

An Environmental Friendly Process for the Synthesis of *f* GO Modified Anion Exchange Membrane for Electro-Membrane Applications

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S1. Chemical and structural characterization:

The Fourier-transform infrared (FTIR) spectra of GO, SGO and dried membranes is recorded using KBr pellet method with a spectrum GX series 49387 spectrometer in the frequency range 4000-400 cm^{-1}. The ^{1}H NMR spectrum of materials are recorded in DMSO-d6 by FT-NMR (200 MHz Bruker PPX-200). X-Ray Diffraction (XRD) of GO, SGO and SGO-1 membrane is recorded on Philips X'Pert MPD System using CuK_{α} radiation with 0.15406 nm within scattering angle range 1 to 80°. Surface characterization of SGO and composite membrane cross section are recorded by scanning electron microscopy (SEM) using LEO microscope after gold sputter coating. Transmission electron microscopy (TEM) images of GO and SGO are obtained on JEOL, JEM 2100 microscope with an accelerating voltage of 200 keV. Atomic Force microscopy (AFM) is used to estimate the surface roughness in semi contact mode on NTEGRA AURA (NTMDT).

S2. Thermo-mechanical stabilities

Investigation of thermal degradation and stability of GO and membranes were done on thermogravimetric analyser (TGA) under N_2 atmosphere on Mettler Toledo TGA/SDTA851e

with stare software, with a heating rate of 10 °C/min from 50 to 600°C. The glass transition behavior of composite membranes was assessed through Differential Scanning calorimetry (DSC) using Mettler Toledo DSC822e thermal analyzer with stare software under temperature range 0 to 200°C. UTM analysis is used to evaluate the mechanical stability of the samples using ISO 527 S2 method using a Zwick Roell Z2.5 tester with a 20 $mm.min^{-1}$ crosshead speed. The testXpert II-V3.5 software is used for data analysis.

S3. Physiochemical Characterization

Water retention capabilities of the membranes were calculated by immersing the membranes in distilled water for 24 h at room temperature. Membranes were weighted immediately after wiping the water drops from membrane surfaces. Weight of dry membranes was also measured after drying for 2 h at 70°C.

$$\emptyset_w = \frac{W_{Wet} - W_{dry}}{W_{wet}} \times 100\%$$

Dimensional change was evaluated by taking the volume difference between wet and dry membranes using the following equation:

$$\emptyset = \frac{V_{Wet} - V_{dry}}{V_{wet}} \times 100$$

Ion exchange capacity (IEC) of the membranes were evaluated by equilibrating in acid-base. Membranes were washed and immersed in 0.1M NaCl (50 ml) for 24h at room temperature to exchange sodium ion with proton in the membranes. After that 10 cm^3 sample solution was titrated against 0.01M NaOH using the following equation:

$$IEC\left(mequiv\ g_{dry\ membrane}^{-1}\right) = \frac{C_{Na^+} V_{sol}}{W_{dry}}$$

where C_{Na^+} is the concentration of Na^+ in the extraction solution, V_{sol} is the volume of titrated or consumed NaOH and W_{dry} is the dried membrane weight.

Counter ion transport number of membranes has been calculated using following equation as reported elsewhere.

$$E_m = \frac{RT(2t-1)}{F} \ln \frac{C_1}{C_2}$$

where R is the gas constant, F is the Faraday constant, t is the transport number of corresponding membrane, T is the absolute temperature (298 ^oK), C_1 and C_2 are the concentration of NaCl in the testing cell.

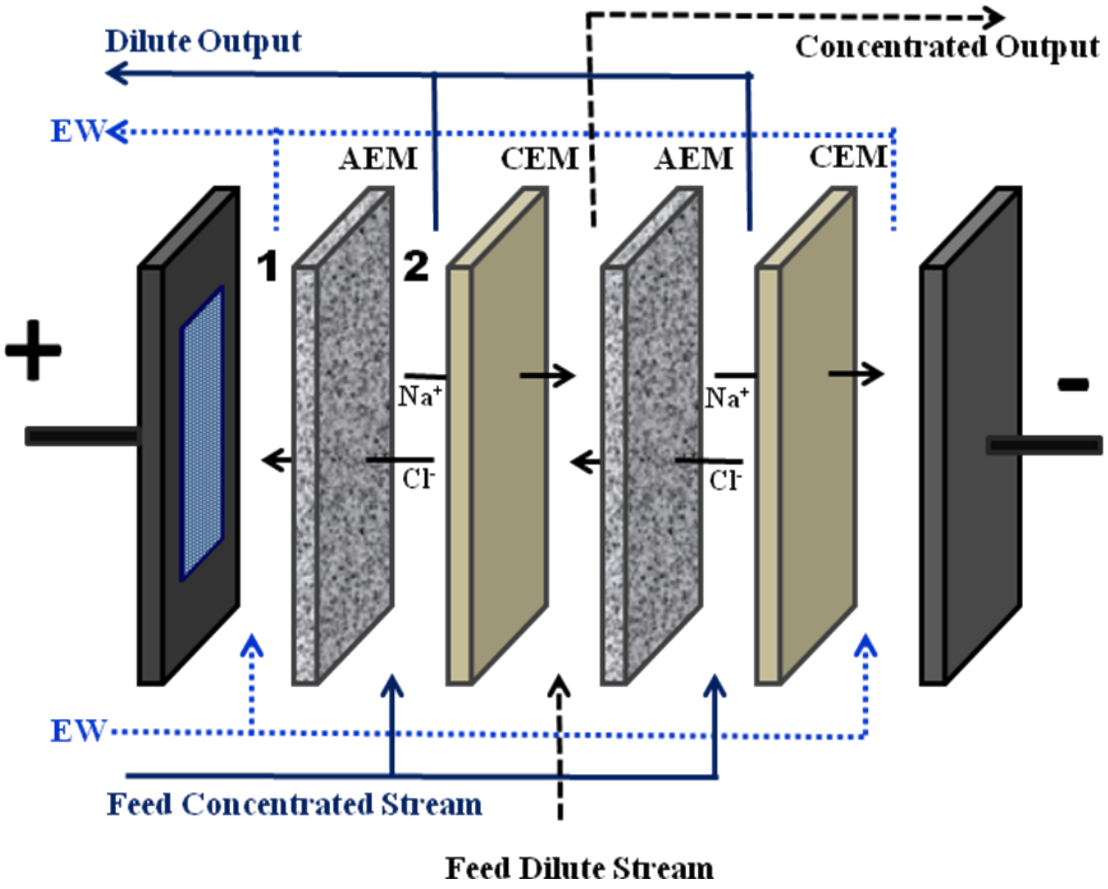

Fig. S-1. Schematic representation of electrodialysis system

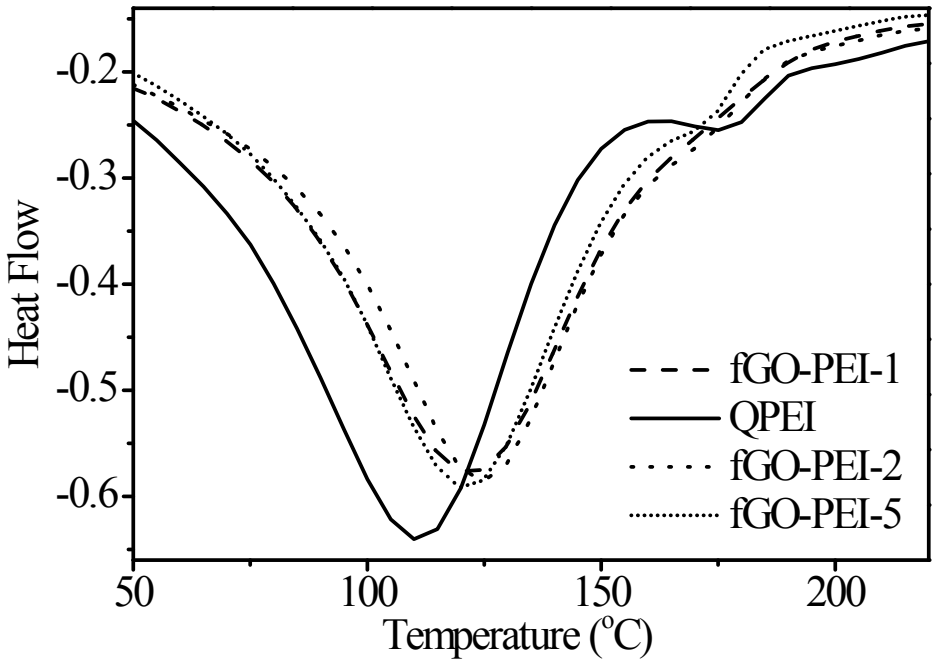

Fig. S-2. DSC thermo-gram for different membranes

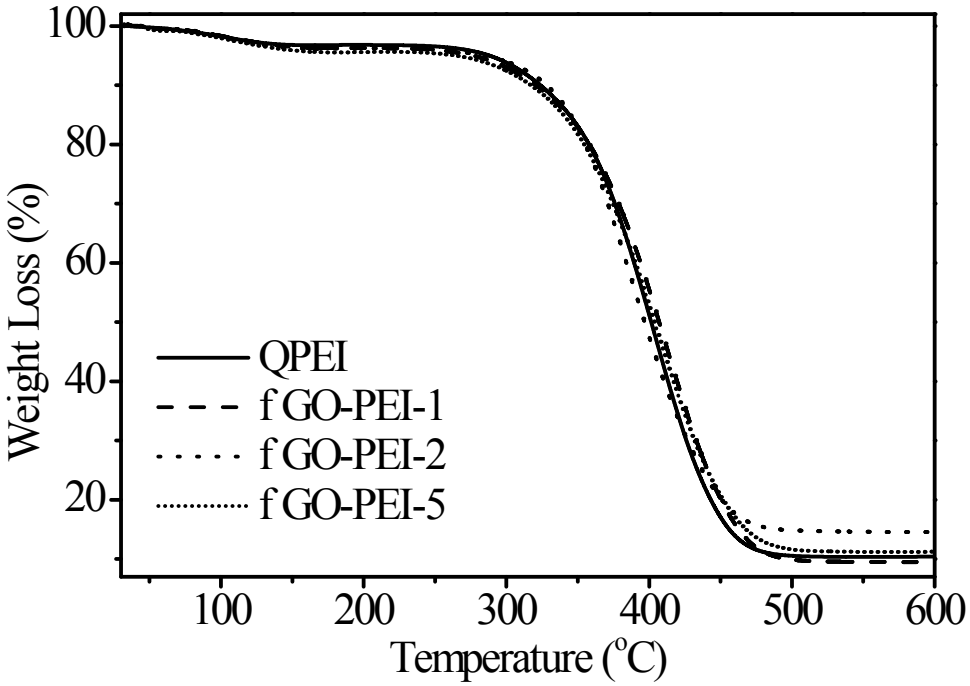

Fig. S-3. TGA thermo-gram for different membranes

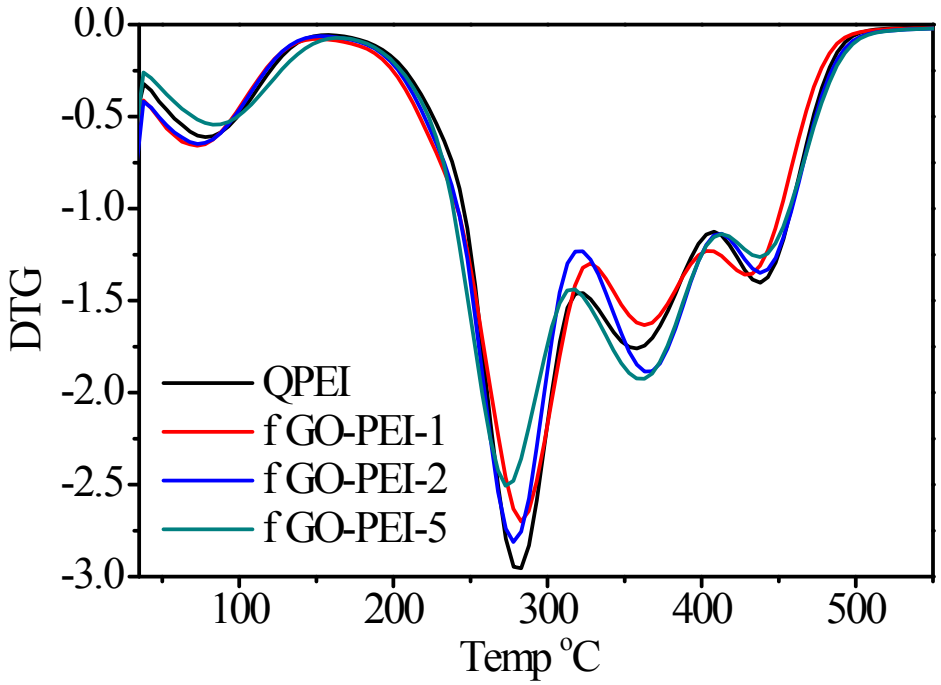

Fig. S-4. DTG thermo-gram for different membranes