Supporting Information for

A green LIB fabrication process using Eastman AQ^{TM} 55S polymer: an efficient low cost and environmentally benign binder

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Experimental

Electrode preparation

The natural graphite from Sigma-Aldrich was dispersed into concentrated nitric acid solution under stirring at 60 ^{o}C for 1 h, and subsequently washed with water until neutral and dried.

The EAQ polymer was dissolved in deionized water to a concentration of 40 mg/ml. The aqueous slurry, containing the modified graphite and EAQ binder, was mixed by a defined amount of graphite and the EAQ binder to meet the desired weight ratios. In order to be used as an anode material in a Li-ion cell, the graphite/EAQ binder slurry was coated onto a 2 cm^2 (1 cm × 2 cm) copper disks and dried by heating at 110 ^{o}C under high vacuum overnight to assume the complete removal of water. The 2 cm^2 copper disks were weighed before and after the coating of electrode material. Then the uncovered 1 cm^2 copper disks were cut down to square shape to fix into the coin cell.

Electrochemical evaluation

The electrochemical behaviour of graphite/EAQ polymer electrodes was tested in a coin cell in terms of galvanostatic discharge-charge cycling tests at ambient temperature using a LAND Instrument Testing System. The cell was assembled using a lithium foil as a counter electrode and 1.0 M $LiPF_6$ in a 1:1 mixture of ethylene carbonate (EC) and dimethyl carbonate (DMC) as the liquid electrolyte (Ferro Corp., USA battery grade). All the above procedures were performed in the inert Ar-filled dry glove box (MBraun Labstar, O_2 and H_2O content $\leq$ 0.1 ppm).

Materials Characterisation

Composite electrode surface images were collected with JEOL 7001F field emission scanning electron microscopy. The in-lens secondary electron detector was used for the studies. Most of which were performed using an accelerating voltage of 5 kV and a working distance of 2-5 mm.

Adhesion measurements of graphite electrode were performed on a Chatillon® TCD225 series force measurement system. The Cu side of graphite electrode (1 cm × 1 cm) was fixed vertically to the bottom sample holder. The adhesive side of a Scotch Magic® tape was firmly applied onto the electrode laminate side. The Scotch Magic® tape was peeled of using the top sample holder at the direction of 180^{o} angle to the adhered tape and parallel to one side of the graphite electrode, and at 10 inch min^{-1} moving rate to the bottom sample holder. A layer of the graphite laminate was peeled off and adhered to the moving scotch magic tape. The force required to peel of the laminate was recorded as indication of the adhesion between the binder and graphite materials. The first data point of each test, between 0 and 0.05 cm, corresponds to the beginning of the tape tension, with the forced offset to zero. When the tension is fully applied and the electrode laminate is peeled off, the measured force value reaches a plateau, representing the adhesion force of the electrode laminates.

Thermogravimetric analyse was conducted in the nitrogen atmosphere with a temperature ramp of 5 ^{o}C/min using the TGA/SDT Q600 from TA Instruments Inc.

Fourier Transform Infrared (FTIR) spectroscopy measurements were performed using a Thermo- Nicolet (Thermo Electron Corporation, USA) Magna 550 FTIR spectrometer equipped with a Thermo-Nicolet Nic-Plan FTIR microscope. For each spectrum 32 scans were collected at a resolution of 4 cm^{-1} from 4000 cm^{-1} to 500 cm^{-1}. All the FTIR data were analysed using OMNIC E.S.P version 6.1a software (Thermo Scientific, USA).

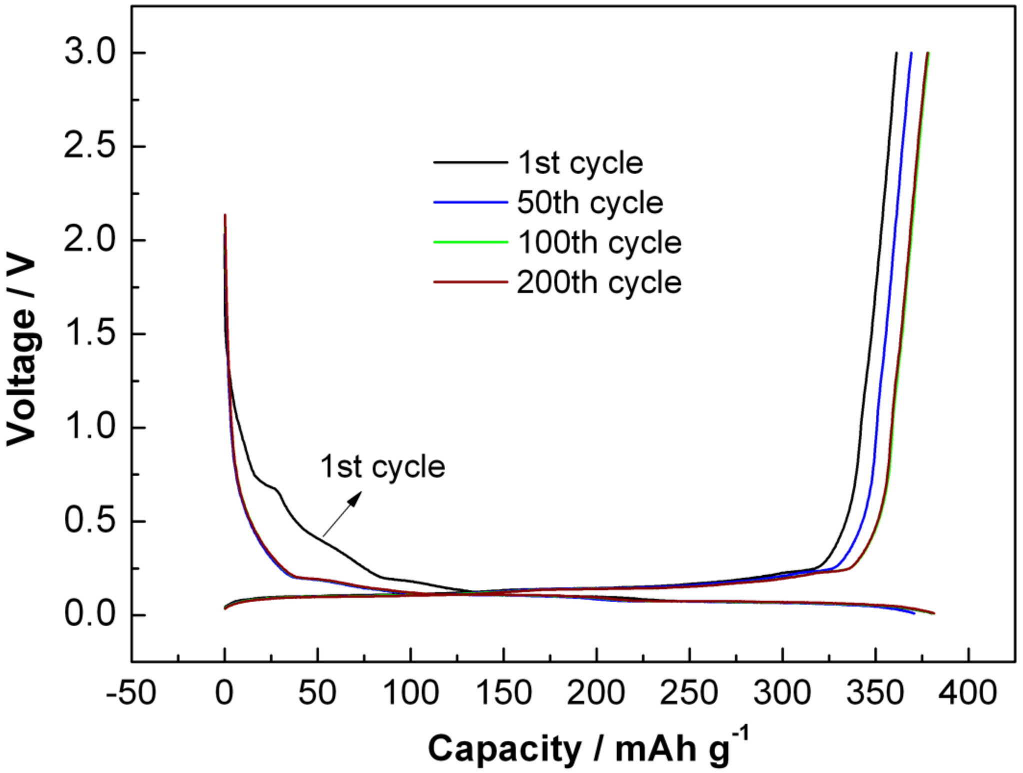

Figure S1. Galvanostatic charge-discharge voltage profiles of oxidized graphite/EAQ electrode at C/10 rate (37.2 mA/g) over the potential window of 0.01-3 V (versus Li/Li$^+$).

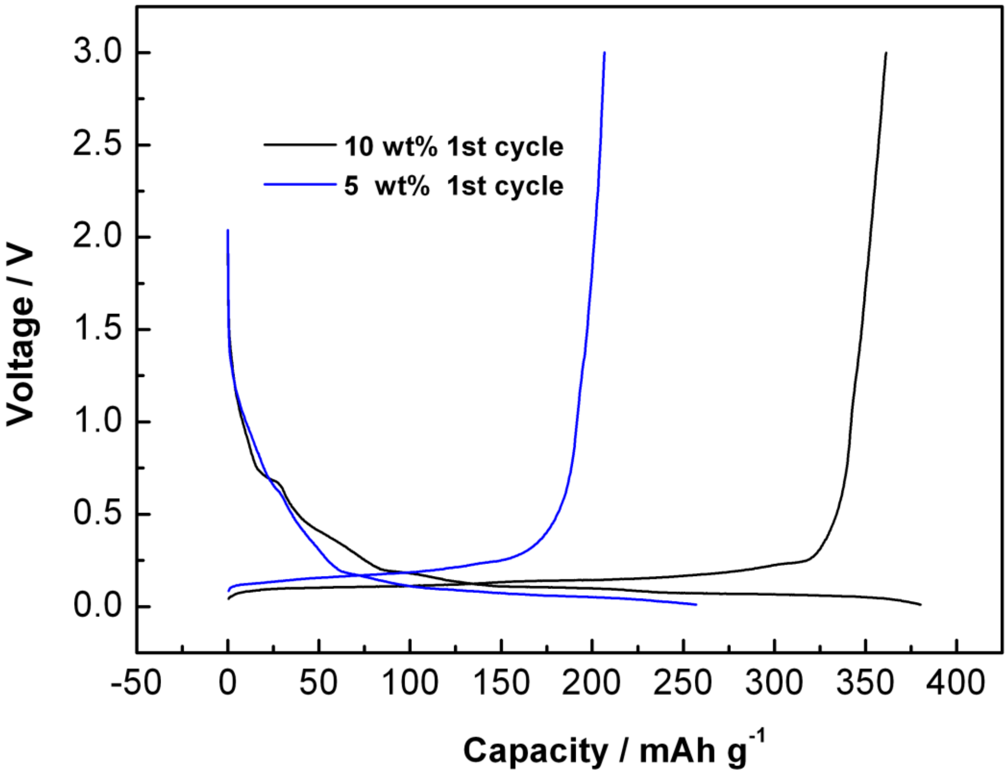

Figure S2. Galvanostatic charge-discharge voltage profiles of oxidized graphite electrodes combined with different percent of EAQ binder at C/10 (37.2 mA/g) in the range of 0.01-3 V (versus Li/Li^+).

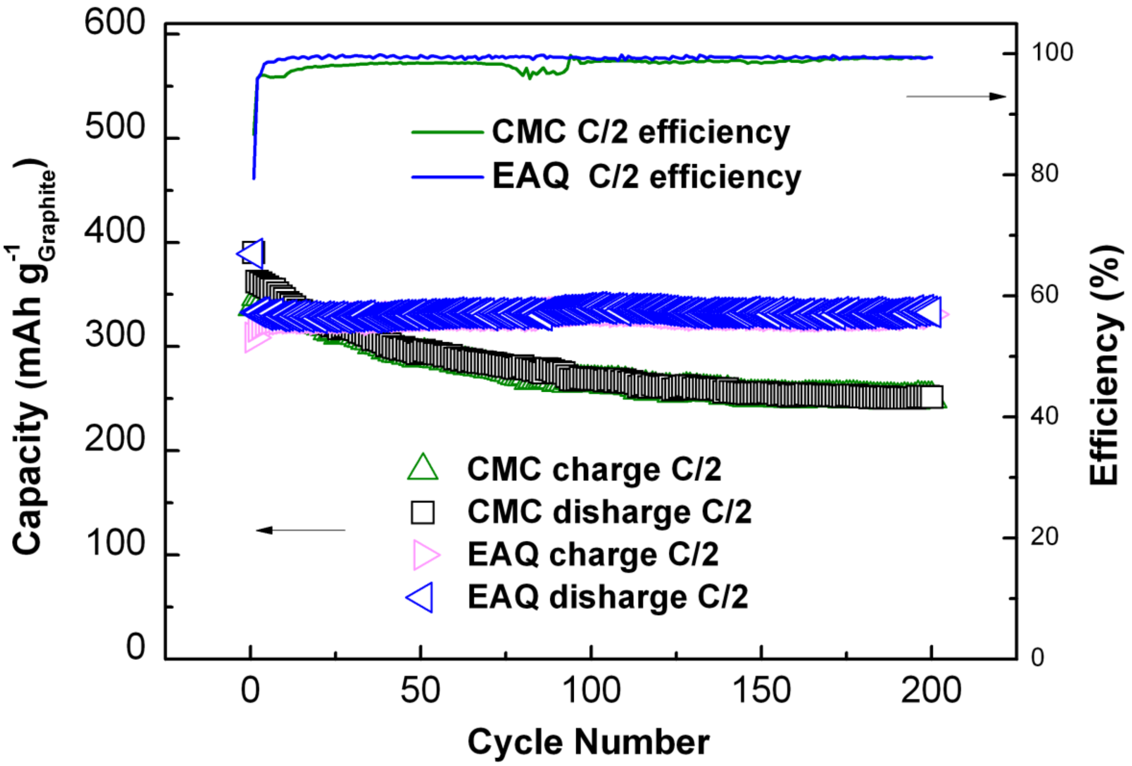

Figure S3. Comparison of electrochemical cycling performance of the oxidized graphite/EAQ and oxidized graphite/CMC electrodes at C/2 (186 mA/g) in the range of 0.01-3 V (versus Li/Li^+).

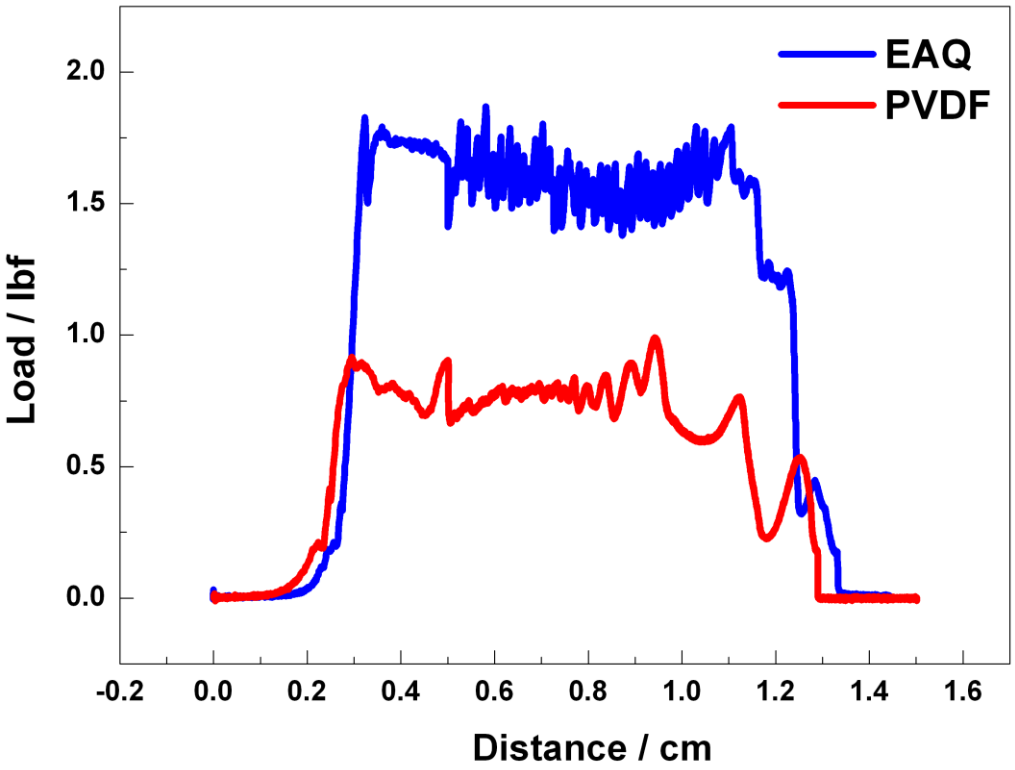

Figure S4. Peeling test of oxidized graphite electrodes on copper foil using EAQ and PVDF polymer binders separately.

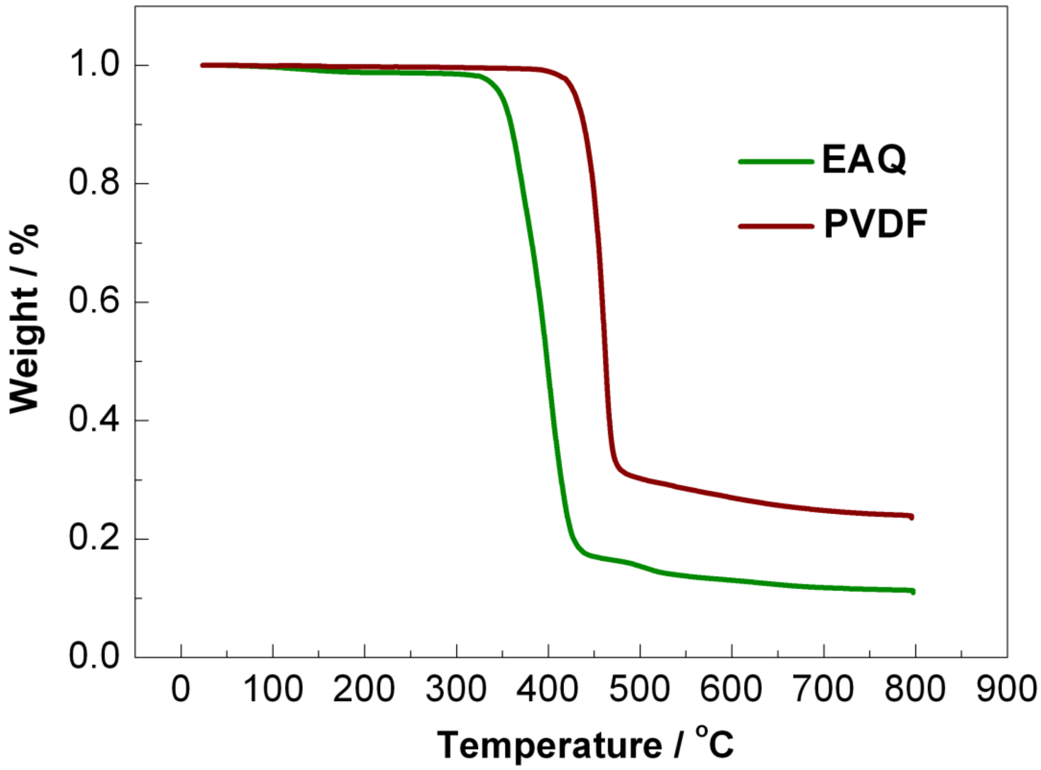

Figure S5. Thermal gravimetric analysis (TGA) plots of EAQ and PVDF polymer binder in the nitrogen atmosphere with the ramp 5 ^{o}C/min to 800 ^{o}C.

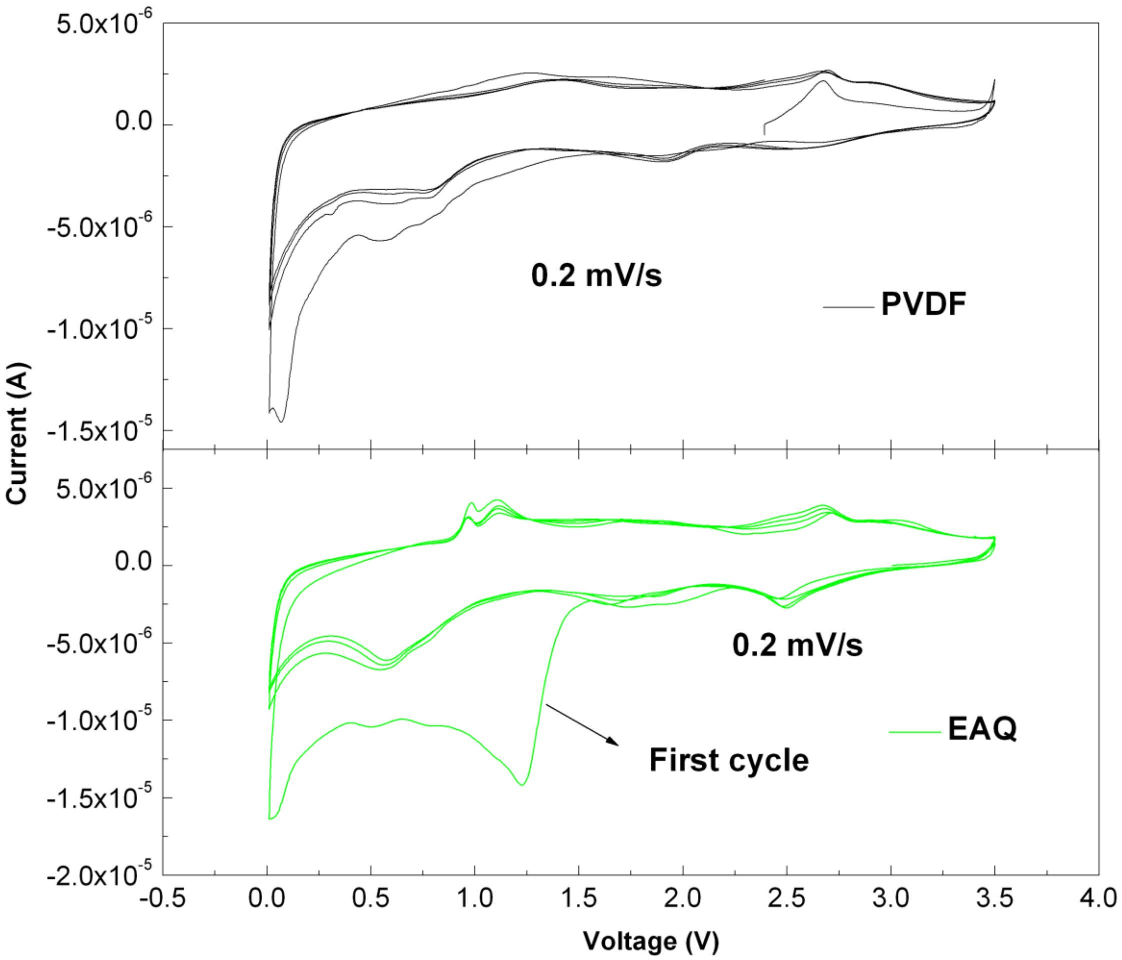

Figure S6. Cyclic voltammetry (CVs) measurements for evaluating the electrochemical stability of the EAQ and PVDF polymer binders at a scan rate of 0.2 mV/s over the potential window of 0.01-3.5 V.