Electronic Supplementary Material (ESI) for Journal of Materials Chemistry
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Supplementary Data

Title: **Superior performance of a vapor grown carbon fiber polymer actuator containing ruthenium oxide over a single-walled carbon nanotube**

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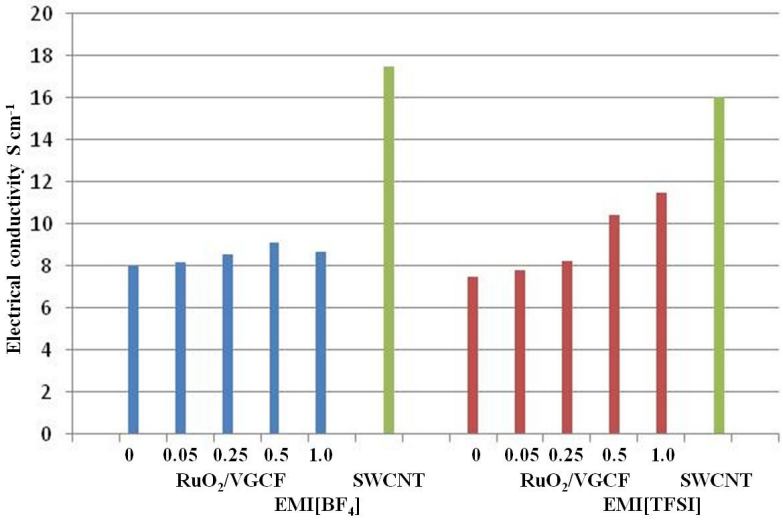

Fig. S1 Compare to an electrical conductivity of various polymer-supported nanocarbon/IL gel electrode layer containing the RuO_2.

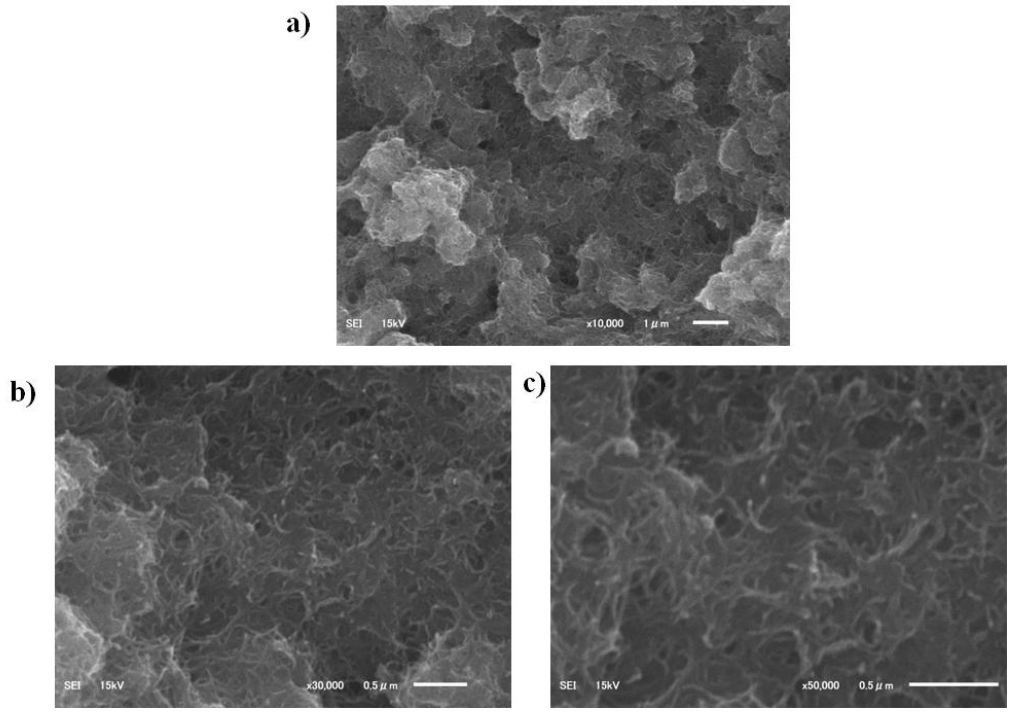

Fig. S2 SEM micrographs of the polymer-supported bucky-gel electrode layer (composition of 20 wt% VGCF, 48 wt% EMI[BF_4] and 32 wt% PVdF(HFP)); a) magnification 10,000× b) magnification 30,000× c) magnification 50,000×

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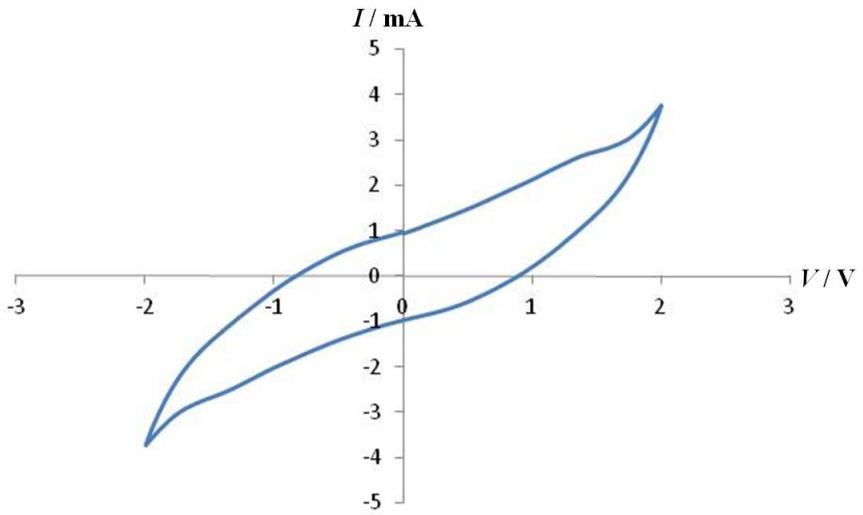

Fig. S3 CV of a cell system composed of an IL (EMI[TFSI]) electrolyte sandwiched by two bucky-gel electrode layers (RuO_2:VGCF = 1.0) (applied triangular voltage: ±2.0 V, sweep rate = 40 mV s^{-1} (0.005 Hz)).

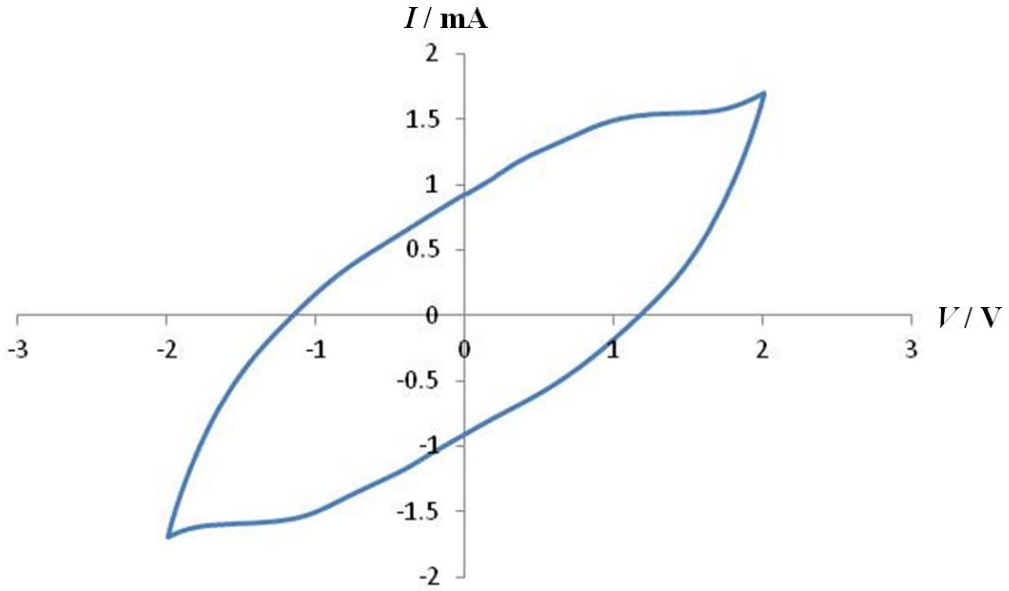

Fig. S4 CV of a cell system composed of an IL (EMI[BF_4]) electrolyte sandwiched by two bucky-gel electrode layers (RuO_2:VGCF = 1.0) (applied triangular voltage: ±2.0 V, sweep rate = 40 mV s^{-1} (0.005 Hz)).

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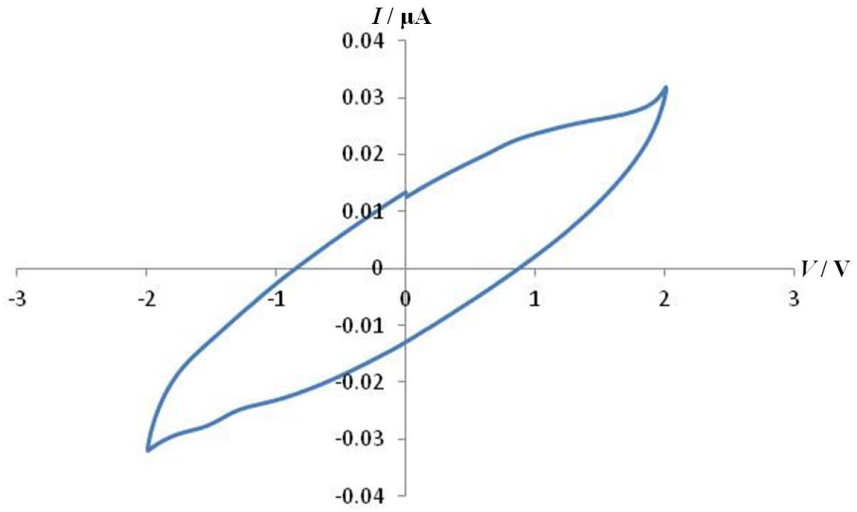

Fig. S5 CV of a cell system composed of an IL (EMI[TFSI]) electrolyte sandwiched by two no-VGCF-gel electrode layers ($RuO_2 \cdot xH_2O$/EMI[TFSI]/PVdF(HFP) (=5:12:8)) (applied triangular voltage: ±2.0 V, sweep rate = 40 mV s^{-1} (0.005 Hz)).

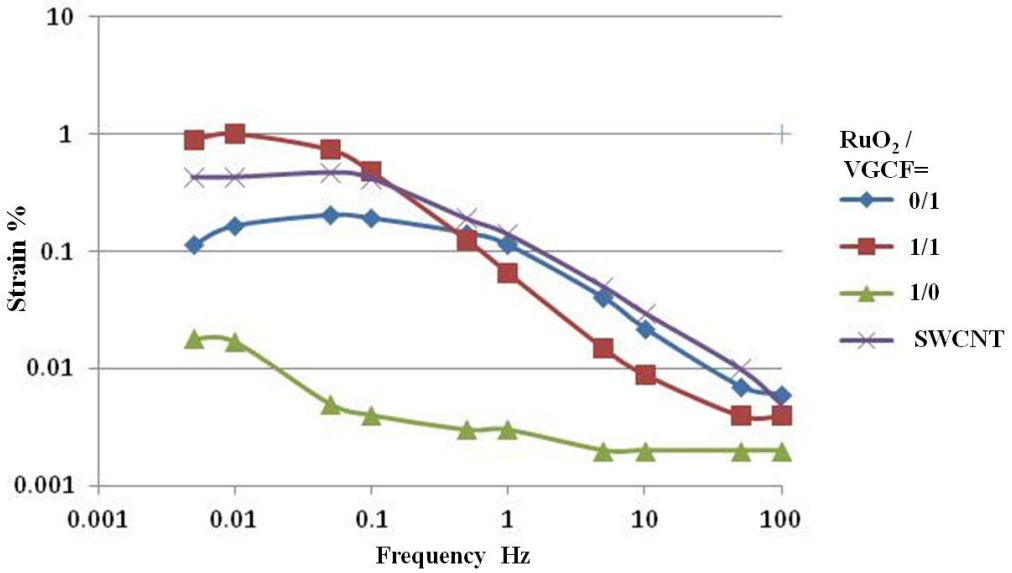

Fig. S6 Comparison of the strain calculated from the peak-to-peak value of displacement for the polymer-supported nanocarbon/EMI[BF_4] gel actuator and the polymer-supported no-nanocarbon/EMI[BF_4] gel actuator containing RuO_2 as a function of the applied triangular voltage (±2 V) frequency.

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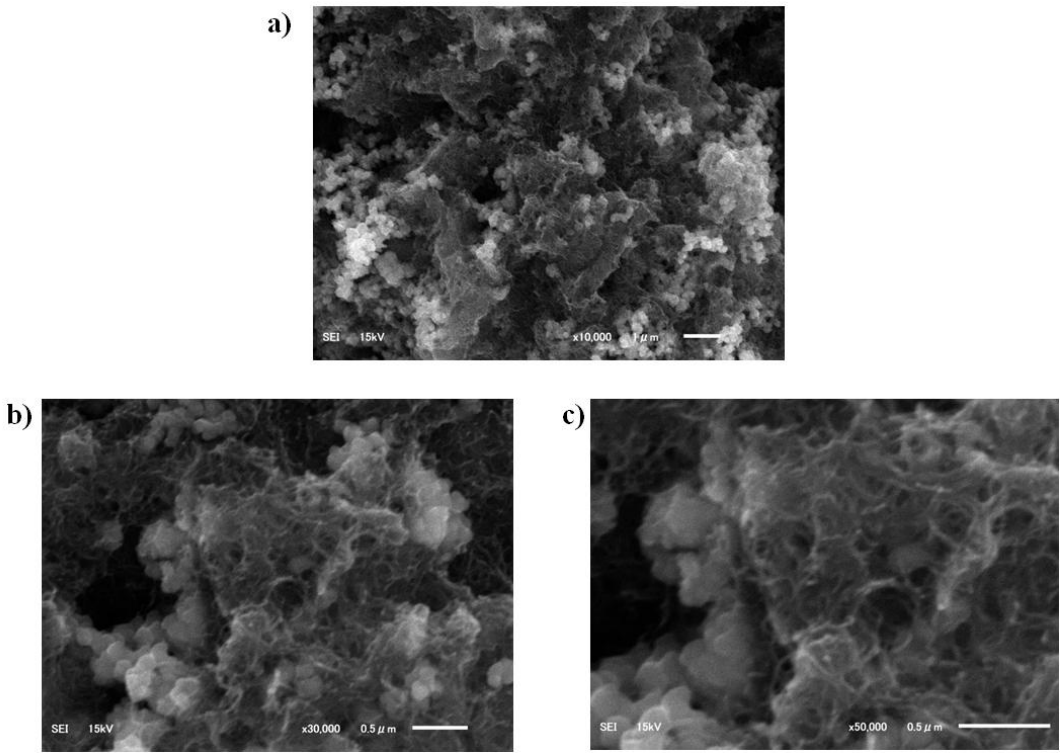

Fig. S7 SEM micrographs of the polymer-supported bucky-gel electrode layer (composition of 16.7 wt% VGCF, 16.7 wt% $RuO_2 \cdot xH_2O$, 40 wt% EMI[BF_4] and 26.6 wt% PVdF(HFP)); a) magnification 10,000× b) magnification 30,000× c) magnification 50,000×.

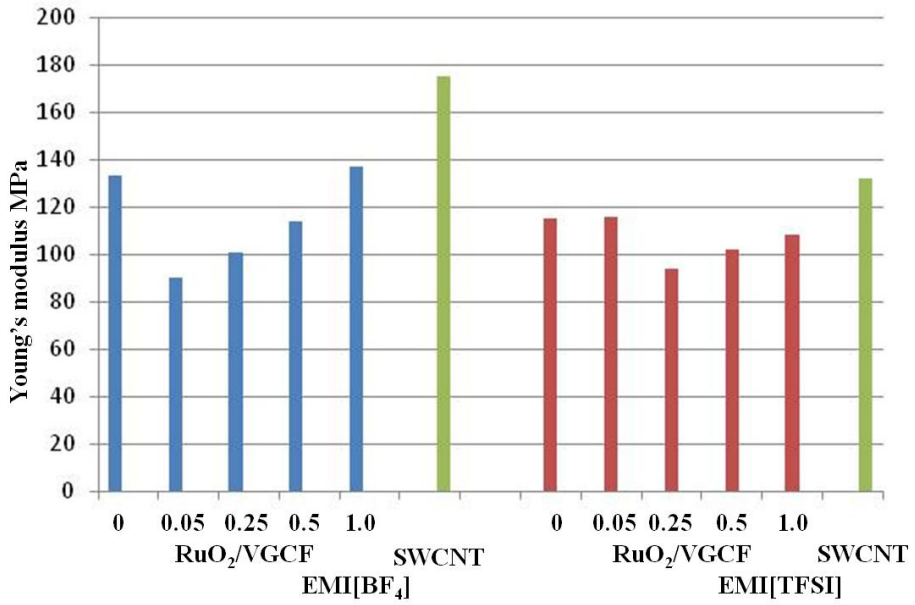

Fig. S8 Comparison of the Young's modulus for various polymer-supported nanocarbon/IL gel electrode layers containing RuO_2 (IL: EMI[BF_4] or EMI[TFSI]).