Electronic Supplementary Material (ESI) for Journal of Materials Chemistry A.

Resolving electron transfer kinetics in porous electrodes via diffusion-less cyclic voltammetry

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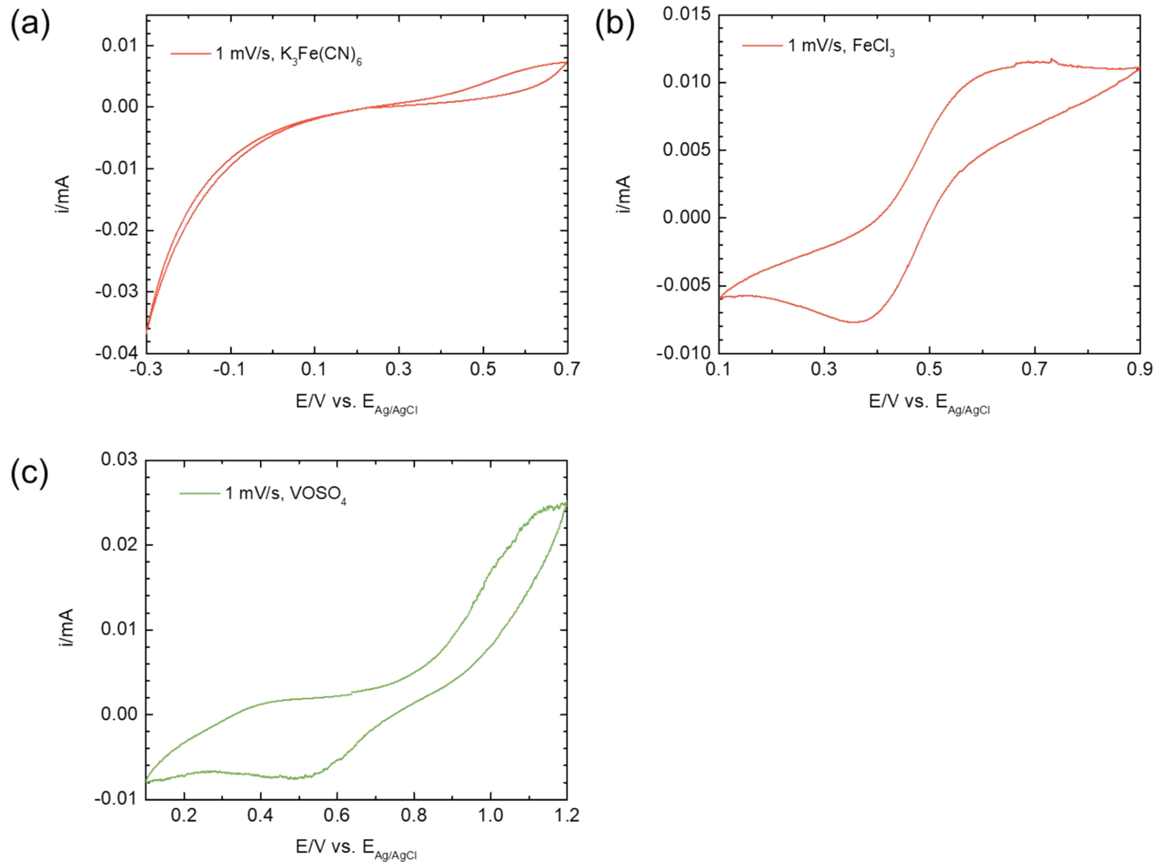

Figure S1. Background current on Ti foil as assembled in the cell with the active electrolyte but without the carbon felt. (a) $K_3Fe(CN)_6$, (b) $FeCl_3$, and (c) $VOSO_4$. The currents are at least two orders of magnitude lower than those measured with the carbon felt for all three cases, so no background subtraction is necessary for the analysis.

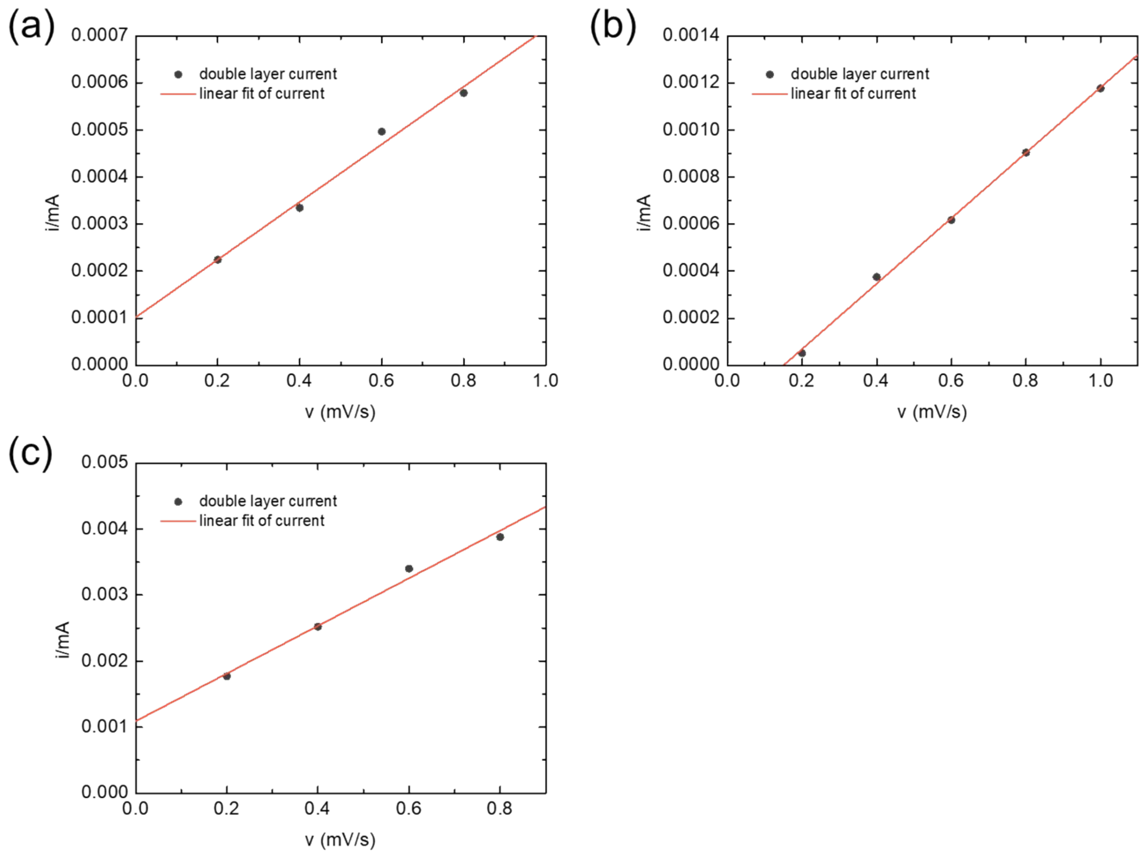

Figure S2. Electrochemical surface area measurements of the carbon felt electrode in the electrolytes of (a) $K_3Fe(CN)_6$, (b) $FeCl_3$, and (c) $VOSO_4$. We scan CV in ranges of potential with no visible Faradaic current and plot the average currents against the scan rates. The slopes are divided with a specific capacitance of 20 μF/ cm^2 to derive the areas.

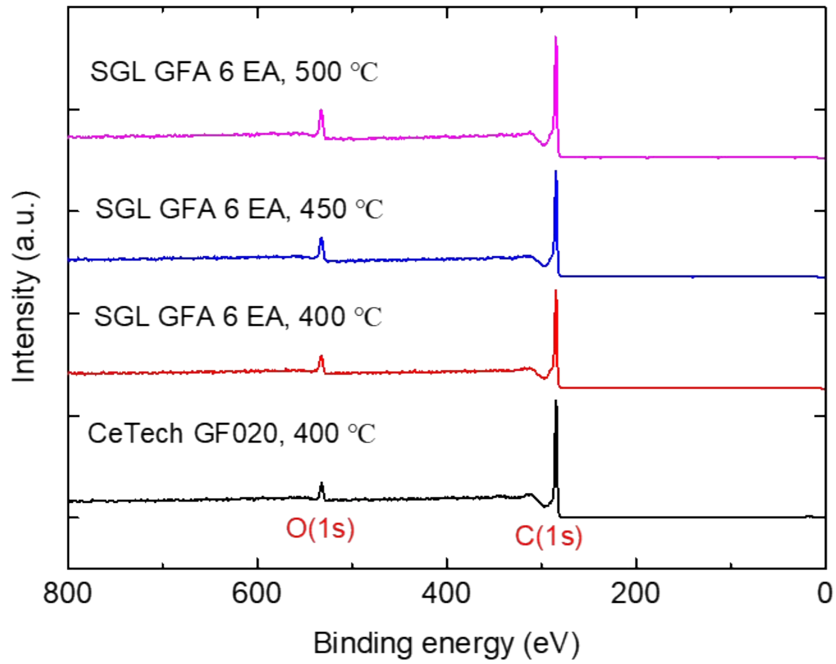

Figure S3. X-ray photoelectron spectra of different carbon felts.

Table S1. O/C ratio of different carbon felts and the corresponding standard rate constants k^0 of VO^{2+}/VO_2^+ on these electrodes.

Carbon Felt	**C ratio/%**	**O ratio/%**	**O/C**	k^0 **(cm/s)**
CeTech CF020, 400 °C	92.51	7.49	0.081	$1.56 \pm 0.15 \times 10^{-6}$
SGL GFA6EA, 400 °C	90.14	9.86	0.109	$1.642 \pm 0.072 \times 10^{-7}$
SGL GFA6EA, 450 °C	89.34	10.66	0.119	$2.095 \pm 0.518 \times 10^{-7}$
SGL GFA6EA, 500 °C	88.93	11.07	0.124	$2.455 \pm 0.216 \times 10^{-8}$

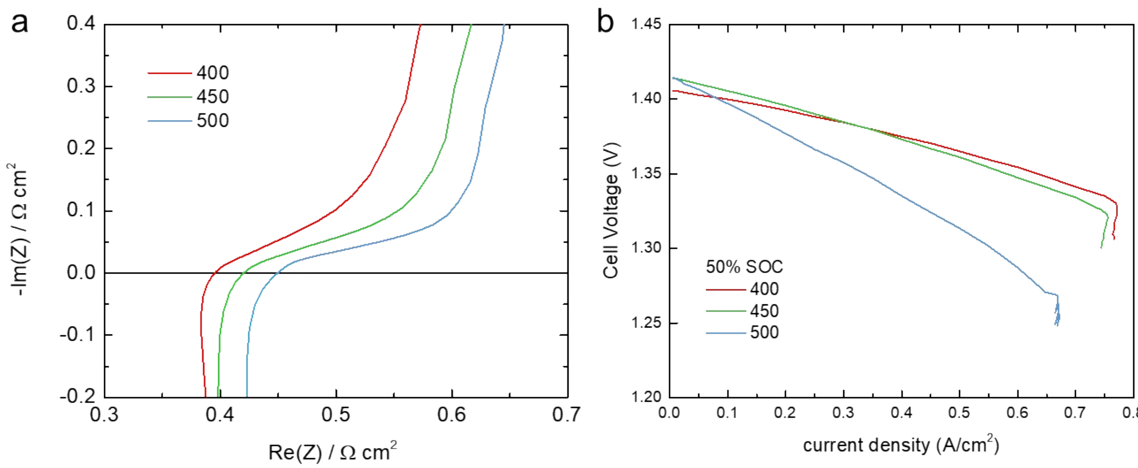

Figure S4. Additional results of the RFB tests. (a) Electrochemical impedance spectroscopy (EIS) and (b) IR-corrected polarization curves of VRFB with CF baked at different temperatures.

Table S2. Polarization resistance of VRFB with different CF.

SGL CF	Ru/Ω cm^2	polarization resistance/Ω cm^2	corrected polarization resistance/Ω cm^2
400℃	0.395	0.487	0.092
450℃	0.421	0.540	0.119
500℃	0.450	0.664	0.214

Table S3. Summary of standard rate constants *k* of VO^{2+}/VO_2^+ reported in literature.

Electrodes	**Treatment**	**Method**	**Area**	***k* (cm/s)**	**Ref**
SGL Carbon GFD4.6	Baked at 400 °C for 12 hrs	Symmetrical RFB	Electro-chemical	2.38×10^{-6}	[1]
Disk made from carbon felt (SigraCELL GFA6, SGL carbon)	Baked at 400 °C for 30 hrs	Linear sweep voltammetry (LSV)	Geometric	1.6-8.8×10^{-8}	[2]
Ultra-microelectrode made from carbon felts (GrafTech)	Electrochemical oxidation and reduction	LSV and EIS	Electro-chemical	1.7-17×10^{-5}	[3]
Carbon felt (Sigratherm GFA5)	Not mentioned	Galvanic charging / discharging	Calculated	3×10^{-7}	[4]
Carbon felt (Liao Yang Carbon Fiber Sci-tech. Co., Ltd. China)	None	CV and EIS	Geometric	1.84×10^{-3}	[5]
Carbon paper (29, SGL group)	Baked at 450 °C for 30 hrs	Polarization curve and EIS in a RFB	Electro-chemical	0.2-1.8×10^{-7}	[6]
Carbon paper (10AA, SGL group)	None	Symmetrical RFB	Gas adsorption	2.05×10^{-6}	[7]
Carbon paper (Shanghai Hesen, Ltd. HCP030 N)	Electrochemical oxidation and reduction	CV	Gas adsorption	1.04×10^{-3}	[8]

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