Supplementary Information

Coupling Desalination and Energy Storage with Redox Flow Electrodes

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Supplementary Figures:

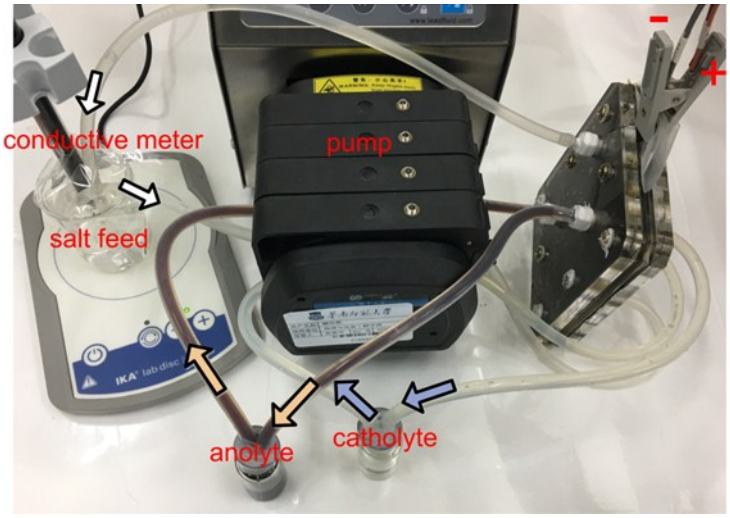

Figure S1. The photograph of an ionic redox flow electrodes for battery deionization used in this report. The anolyte, catholyte, and salt feed are circulated back with the peristaltic pumps.

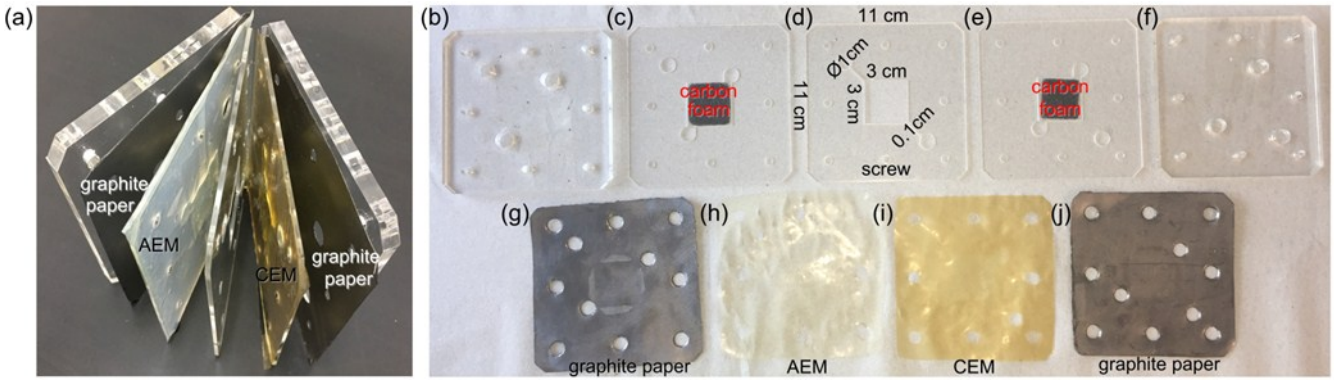

Figure S2. the device photograph of ionic redox flow electrodes for battery deionization, (a) the inside structure of deionization device in sequence (a), the separated parts (b-j). Carbon foam was used to improve the reaction surface area of the electrolyte and electrode.

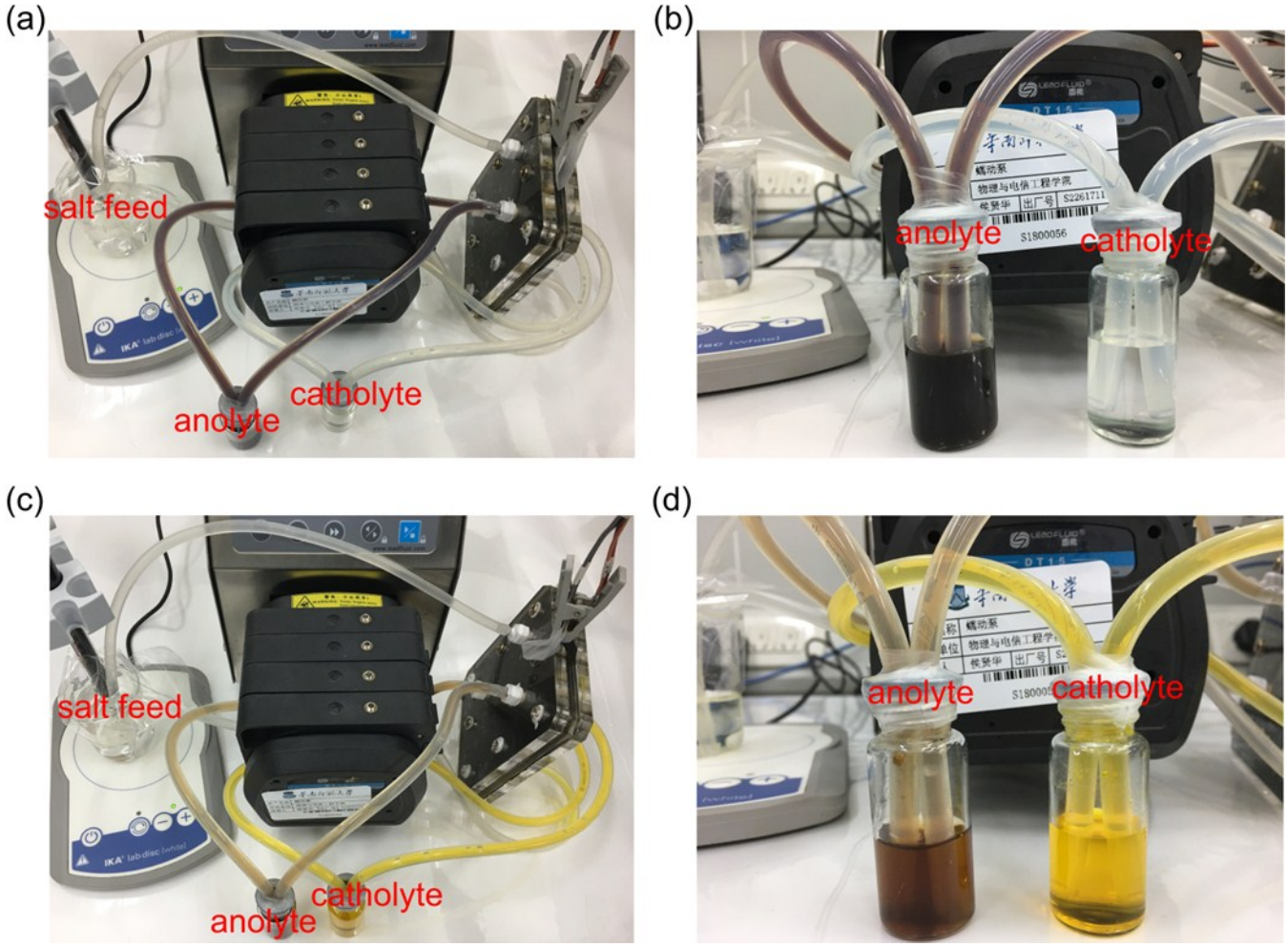

Figure S3. The top view photograph at the initial state (a) and its anolyte/catholyte photograph (b); (c) The top view photograph at the charging state (c) and its anolyte/catholyte photograph (d). Color change of the electrolyte solutions during charging–discharging

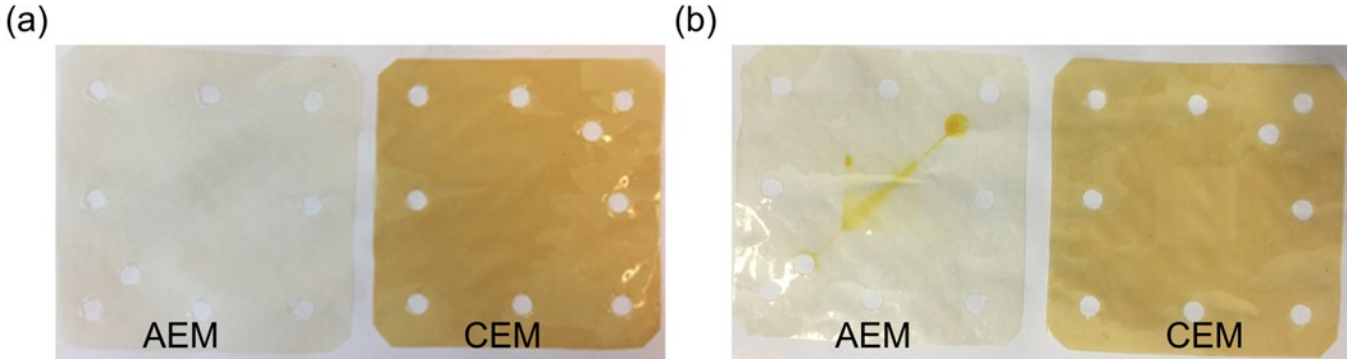

Figure S4. The photograph of AEM and CEM before cycling (a) and after cycling (b)

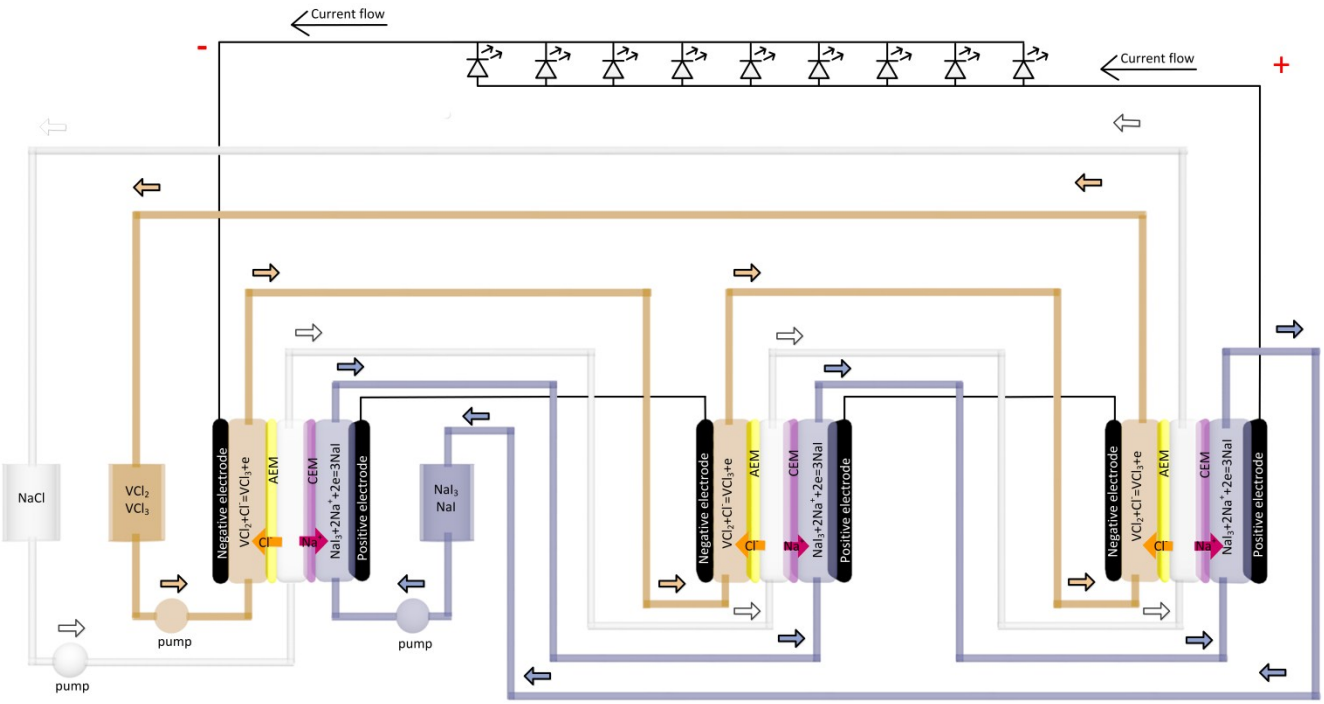

Figure S5. Schematic representation of the discharge-desalination process without external power source; three deionization devices were connected in series, and nine LED bulbs were paralleled during discharge-desalination process. The nine paralleled LED bulbs were lightened on by the three deionization devices without external power source while the salt is removed.

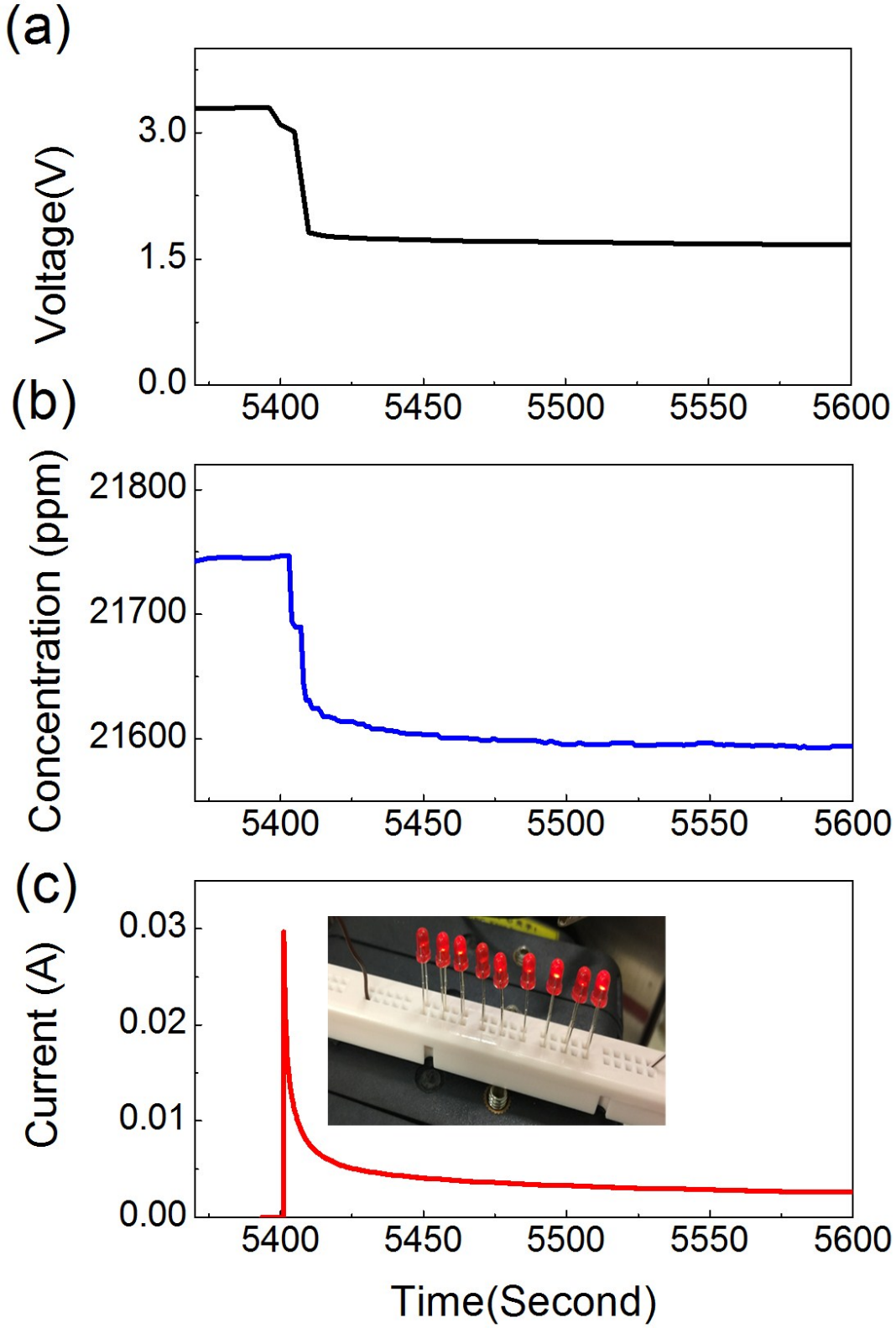

Figure S6. (a) the curve of voltage vs. time with three devices in series during charge-discharge process, (b) the salt concentration change, (c) the current change of nines paralleled LED bulbs during discharge. No external power source is supplied during discharge process. Inserted photograph in (c): nine paralleled LED bulbs are lighted by the three series connected RFBD devices as demonstrated Figure S5.

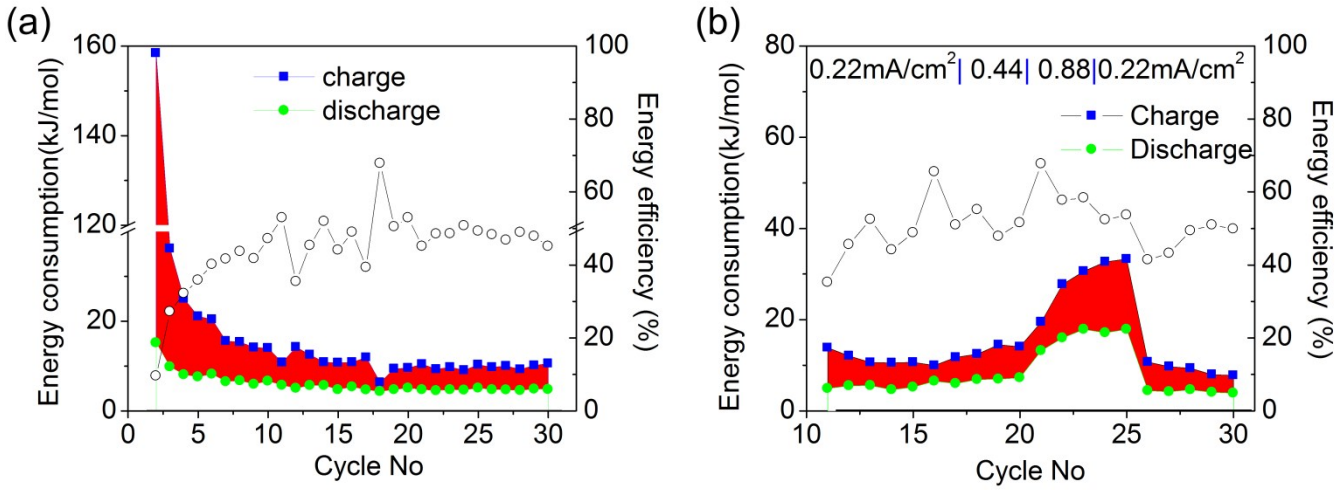

Figure S7 energy consumption/release and energy efficiency during the cycling process (a) and various current density processes (b) for the current RFBD device. The energy consumption without recovery was demonstrated as blue solid square curves. The energy consumption with recovery can be found between the charge/discharge curves within one cycle.

Table S1. The comparison of energy consumption

Technologies	Energy consumption (kJ/mol)	Feed salt concentration (ppm)	References
RO plants	~24	35,000	Ref. [1]
Best reported RO	12.03	35,000	Ref. [2]
Solid electrode dual-ion Faradic deionization	96.88	760	Ref. [3]
Best reported solid electrode Na^+/Cl^- Faradic deionization	26.74	2500	Ref. [4]
[a] Redox flow battery deionization	14.69	35,000	Ref. [5], 3ml salt feed, Energy recovery
[b] A desalination battery NMO-Ag	6.98	35,000	Ref.[6] , 360 uL electrolyte Battery with salt removal function
[c] Rocking chair desalination battery NaNiHCF- NaFeHCF	5.11	35,000	Ref. [7] 0.3ml+0.3ml electrolyte Battery with salt removal function
RFBD(no recovery)	10.27	19,000	This work, 50ml Desalination with energy storage
RFBD(with recovery)	5.38	19,000	This work, 50ml Desalination with energy storage

[a] 2.11 Wh/L, 85% removal efficiency, 35,000 ppm feed, 3ml electrolyte, absence of pumping losses
[b] 0.29 Wh/L, 25% removal efficiency, 35,000 ppm feed, 360 uL electrolyte
[c] 0.34 Wh/L, 40% removal efficiency, 35,000 ppm feed, 0.3ml+0.3ml electrolyte

Reference:

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