Supporting Information

The influence of Flow Field Design on Zinc Deposition and Performance in a Zinc-iodide Flow Battery

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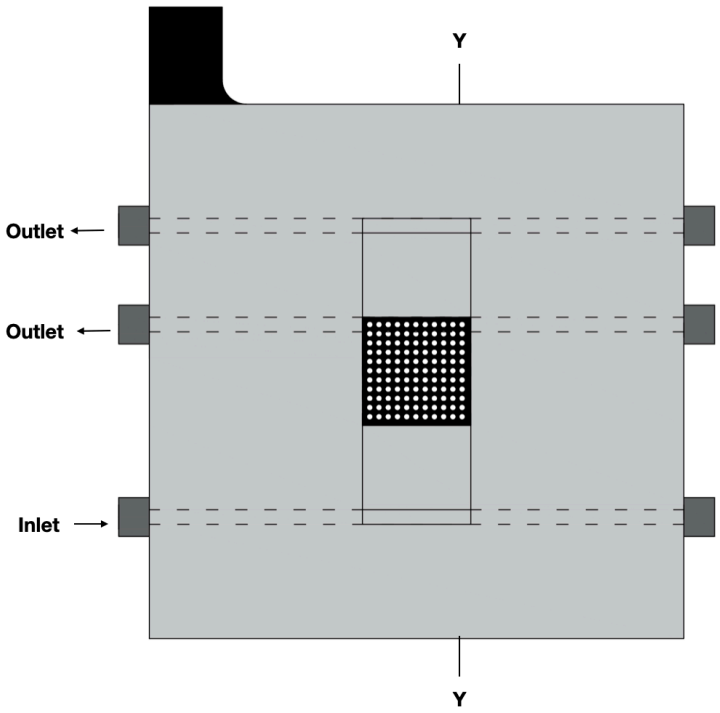
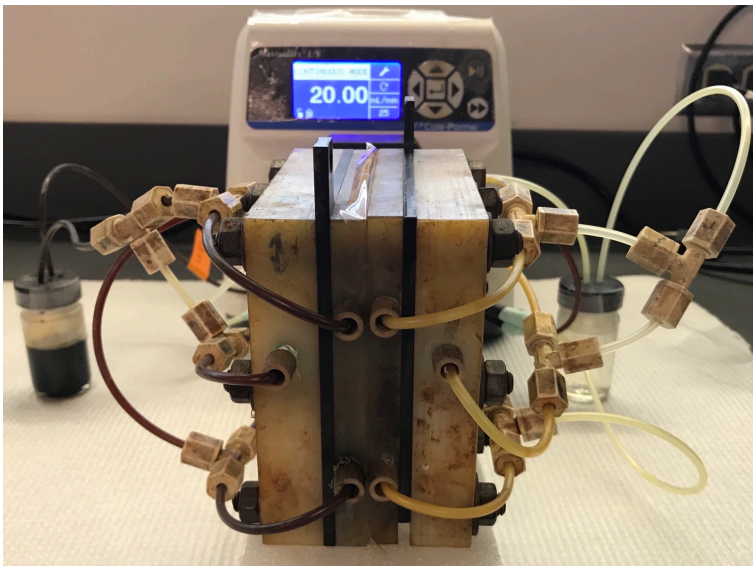
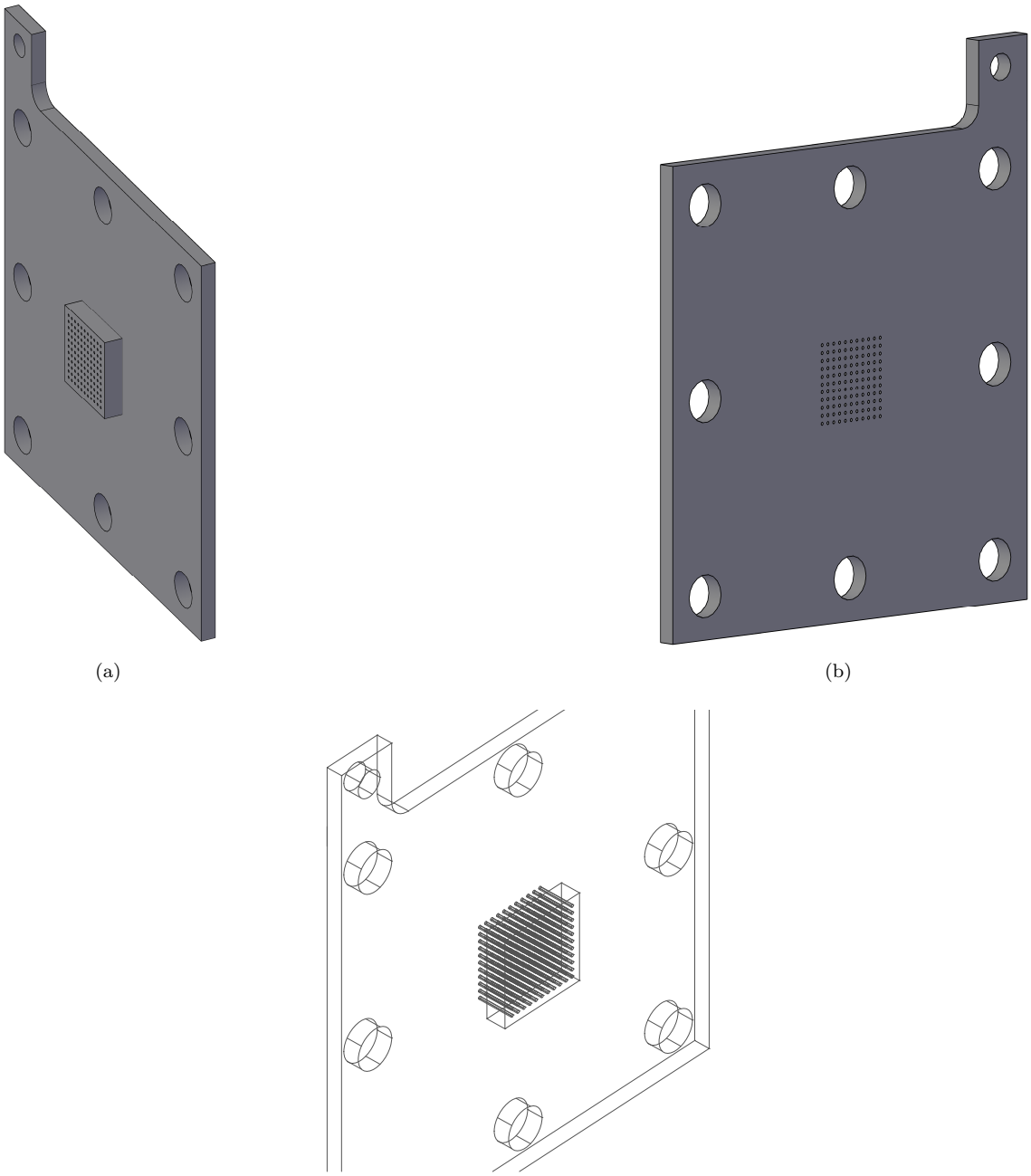


(a)



(b)

Figure S1: Illustration of the design of the zinc-iodide RFB test cell, **(a)** cross section X-X of the test cell, **(b)** photograph of zinc-iodide test cell.



(a) (b)

(c)

Figure S2: **(a)** Specification and physical appearance of perforated graphite plate, **(a)** side view, **(b)** the side in contact with end plate, and **(c)** perforation pattern in the central area of the graphite plate and behind the electrode.

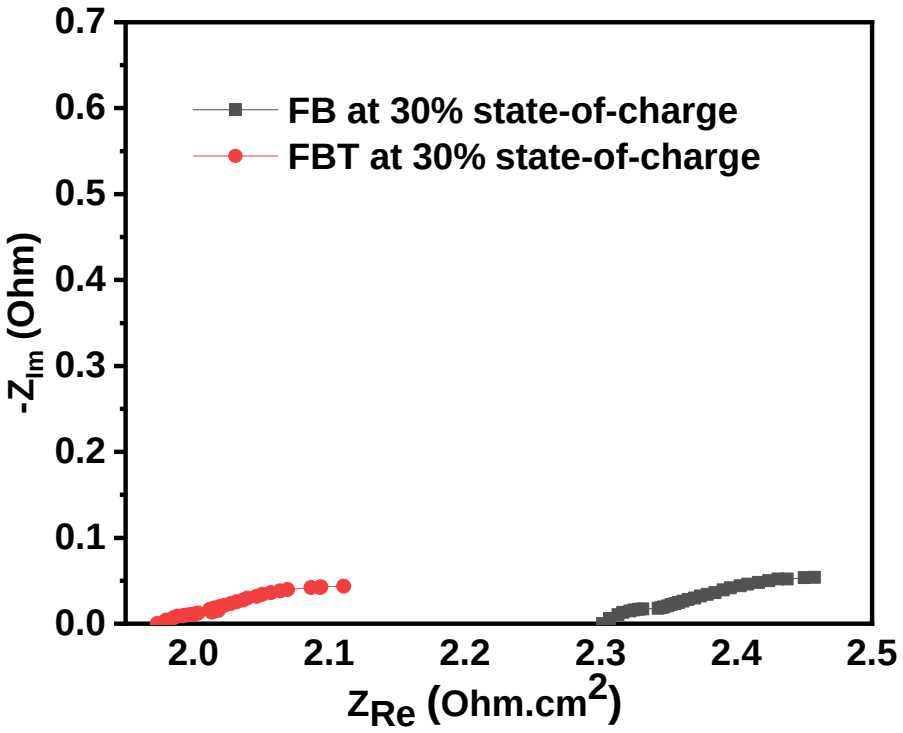


Figure S3: Impedance analysis data at 30 % state-of-charge at AC frequency range of 100 kHz-0.1 Hz. The intercept with the real impedance axis (Z_{Re}) at high frequency region indicates the ohmic resistance multipled by active surface area of the electrode at two different flow field designs.

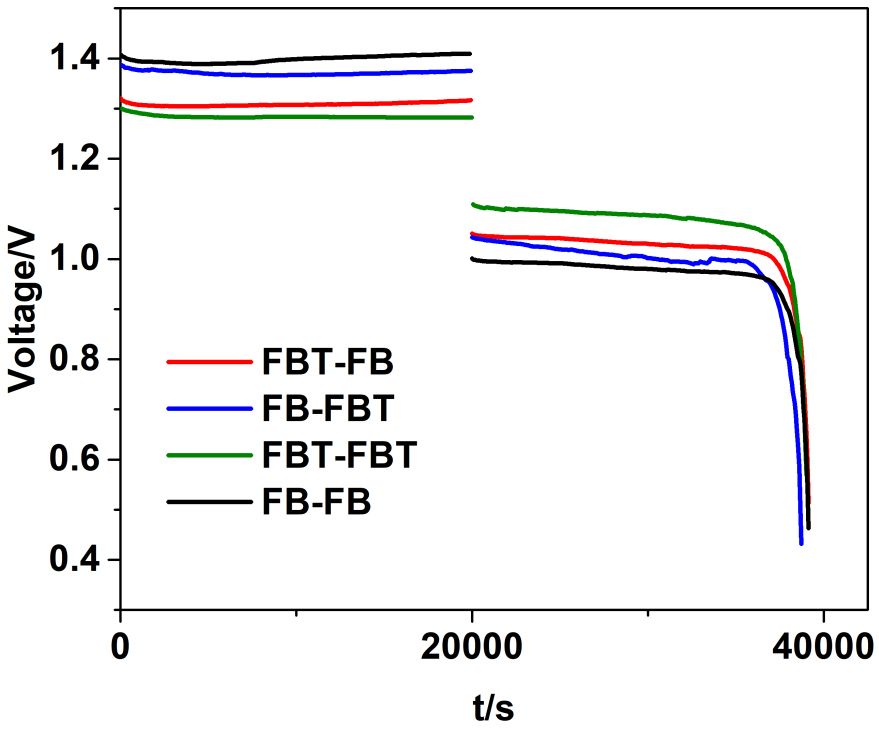


Figure S4: The impact of flow field arrangement on each side of the battery, **FBT-FB** indicates flow-by-through in the zinc side and flow-by in the iodine side, **FB-FBT** indicates flow-by in the zinc side and flow-by-through in the iodine side.

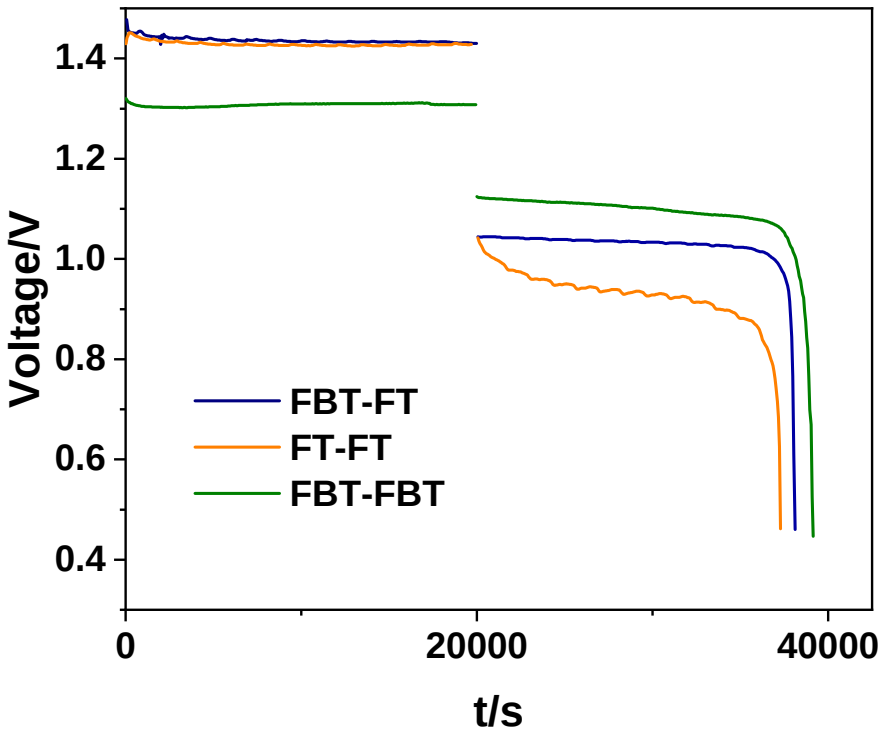
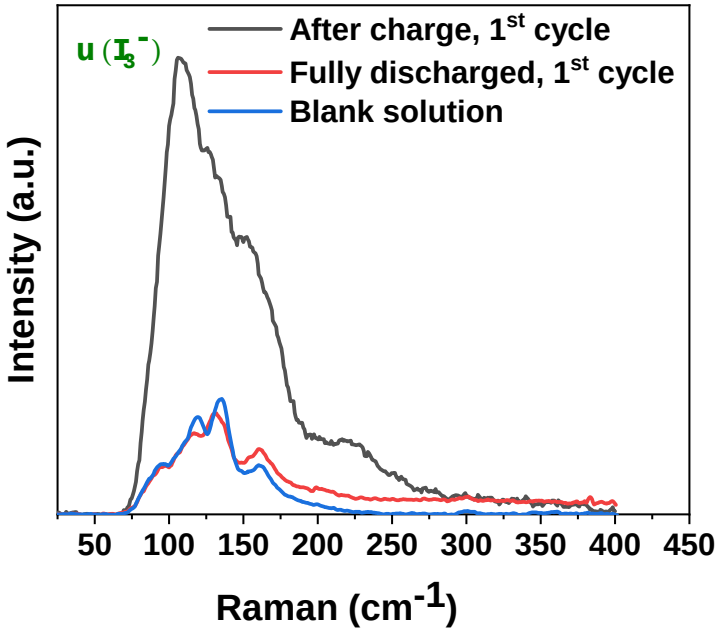
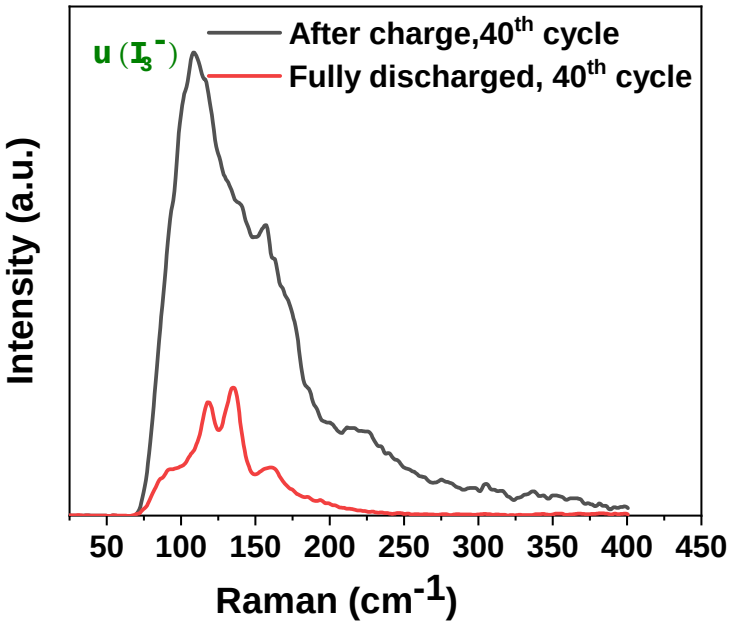


Figure S5: Galvanostatic voltage profile for evaluation the flow-through design on the zinc-idide performance, current density is 20 mA cm^{-2}, and solution is ZnI_2 3M. **FBT-FT** indicates Flow-by-through arrangement is in the positive side and flow-through mode in the negative side. **FT-FT** indicates flow-through arrangement is in the positive and negative sides of the battery. **FBT-FBT** indicates, flow-by-through arrangement is in positive and negative sides of the battery.

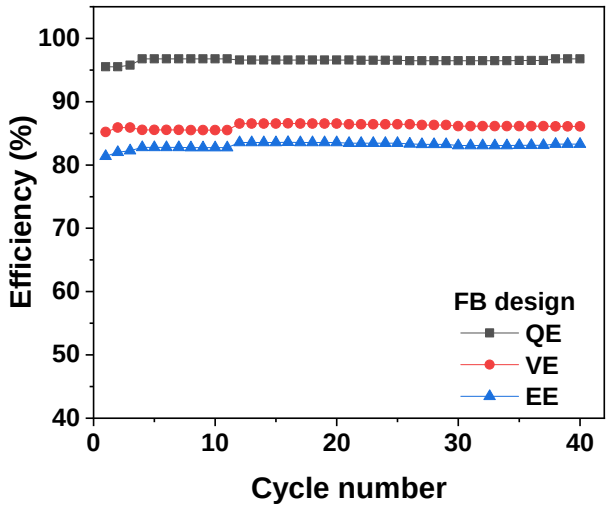


(a)

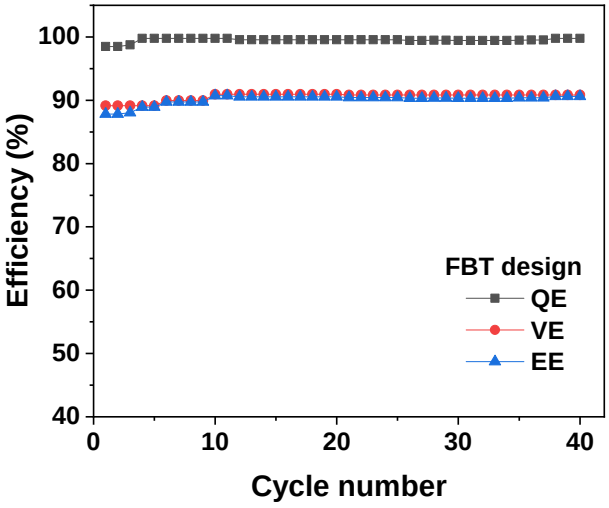


(b)

Figure S6: Raman spectra of catholytes at after battery charging in **(a)** cycle 1^{th} and **(b)** cycle 40^{th} in fixed time with capacity cut off, and after discharging to a cell voltage 0.5 V.



(a)



(b)

Figure S7: Efficiencies during 40 cycles of charge-discharge for ZnI_2 RFB with 3M ZnI_2 (20 mL on each side), Nafion 117 membrane, operating at a current density of 10 mA cm^{-2} with a charge duration of 40,000 s, corresponding to state-of-charge of 25.7% in **(a)** the flow-by (FB) and, **(b)** the flow-by-through (FBT) mode.

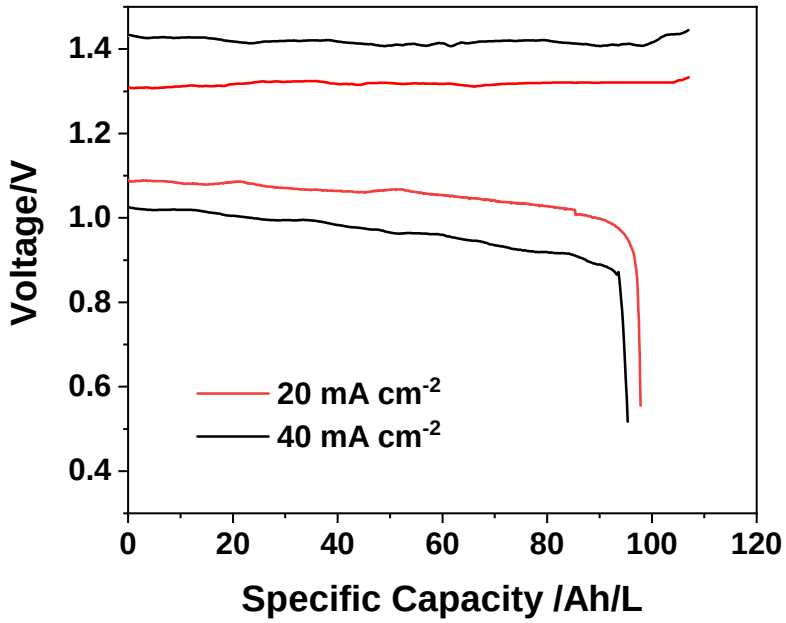


Figure S8: Galvanostatic voltage profile for the flow test cell at different operating current densities of 20 mA cm^{-2} and 40 mA cm^{-2} , and solution is ZnI_2 3M, corresponding to state-of-charge is 100%.

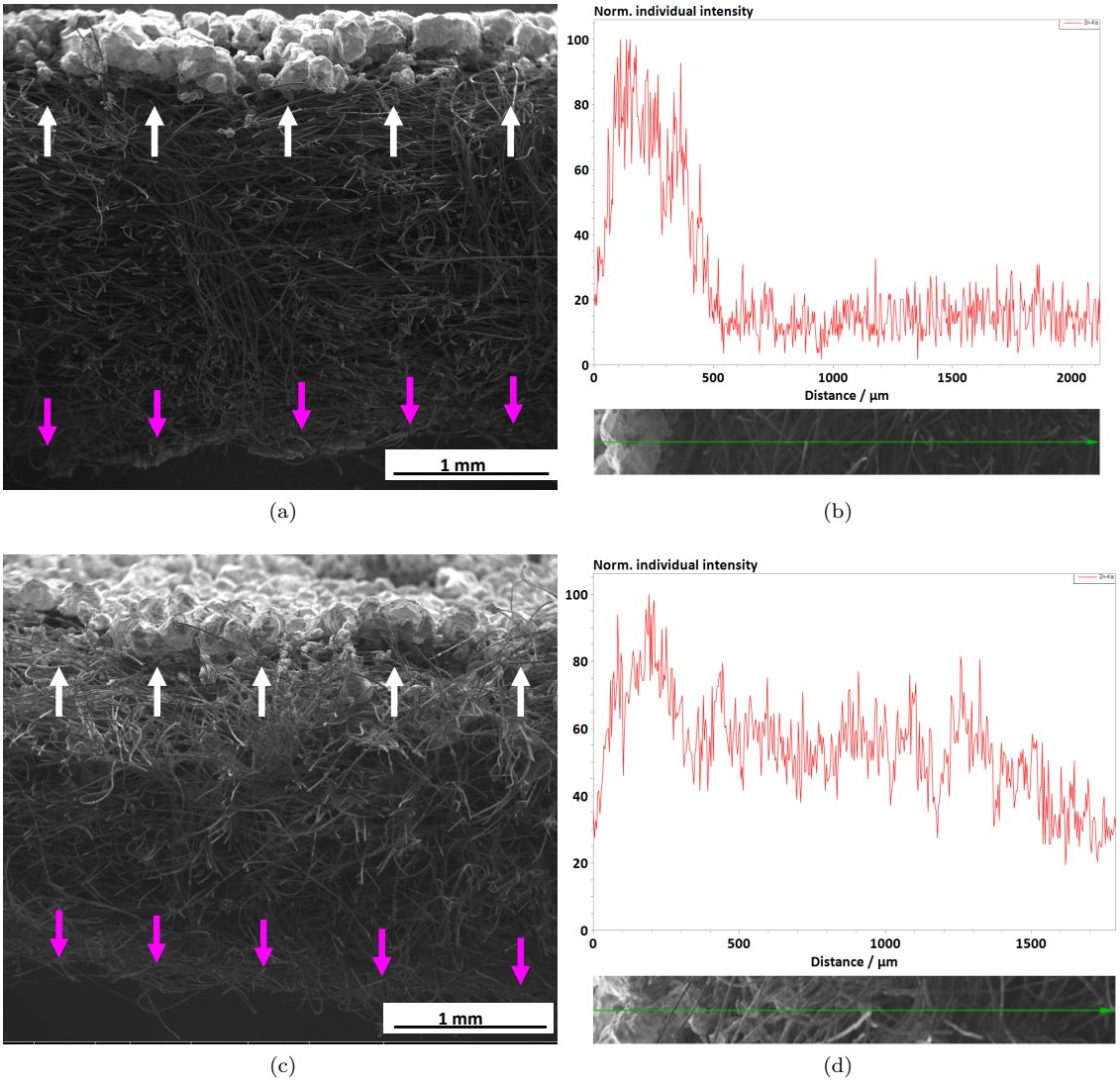
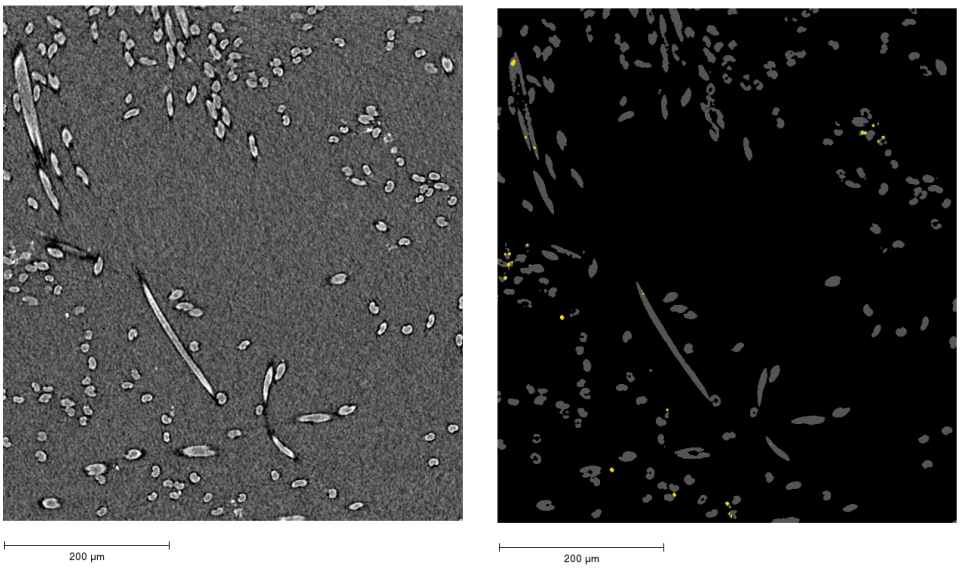
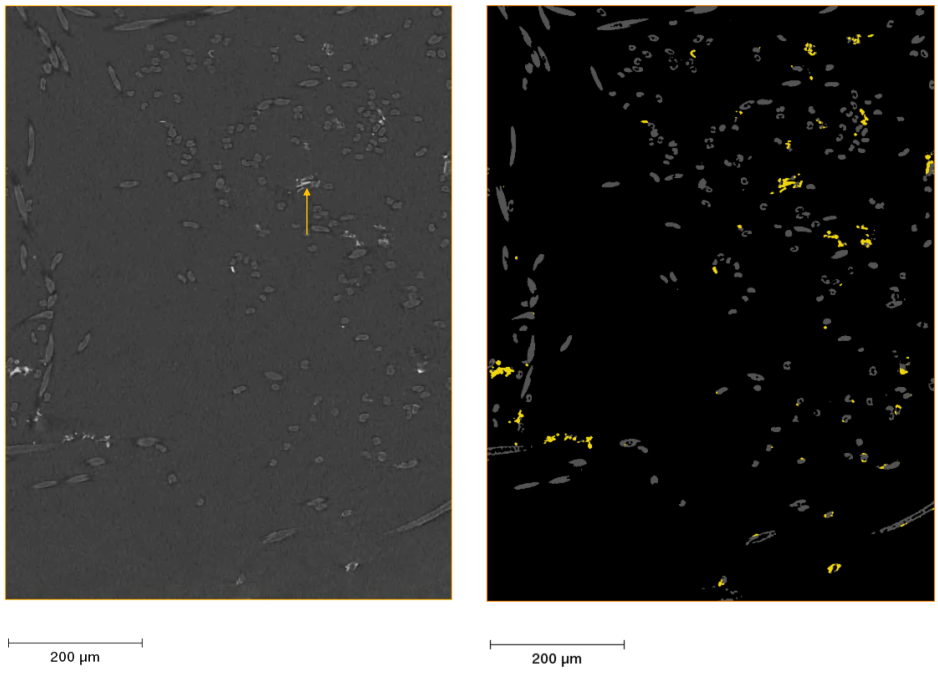


Figure S9: Cross sectional SEM images, and EDS line-scan analysis of the zinc element distribution across of the zinc electrode in the ZnI_2 RFB after charging with an 3 M ZnI_2 electrolyte at a current density of 20 mA cm^{-2}, zinc deposition formed after charging in cycle 40th. The battery was operated in flow-by **(a)** and **(b)**, and flow-by-through **(c)** and **(d)** modes.



(a) (b)

Figure S10: Zinc particles monitored inside the felt in flow-by arrangement, **(a)** 2D virtual slice **(b)** 2D virtual slice of elemental zinc and carbon fiber.



(a) (b)

Figure S11: Zinc particles monitored inside the felt in flow-by-through arrangement, **(c)** 2D virtual slice **(d)** 2D virtual slice of elemental zinc and carbon fiber.

TABLE S1:

Comparing figures of merit and operating conditions for this study in comparison to the literature

System	**Ref**	**Current density mA cm^{-2}**	**Concentration (M)**	**SOC%**	**EE%**	**Cyclability**	**Energy density** WhL^{-1}
ZnI_2 (FBT)	This study	20	3	27.5	85	over 40	30.4 (116 at-SOC of 100%)
ZnI_2 (FB)	This study	20	3	27.5	74	over 40	27.6 (105.5 at SOC of 100%)
ZnI_2	7	10	3.5	100	83	over 40	125
ZnI_2+ $ZnBr_2$	42	10	3.5	70	75	over 40	202
Alkaline ZnI_2	50	20	6	unknown	60-80	limited number	330
FB, flow by; FBT, flow by through. SOC, state-of-charge; EE, energy efficiency							