

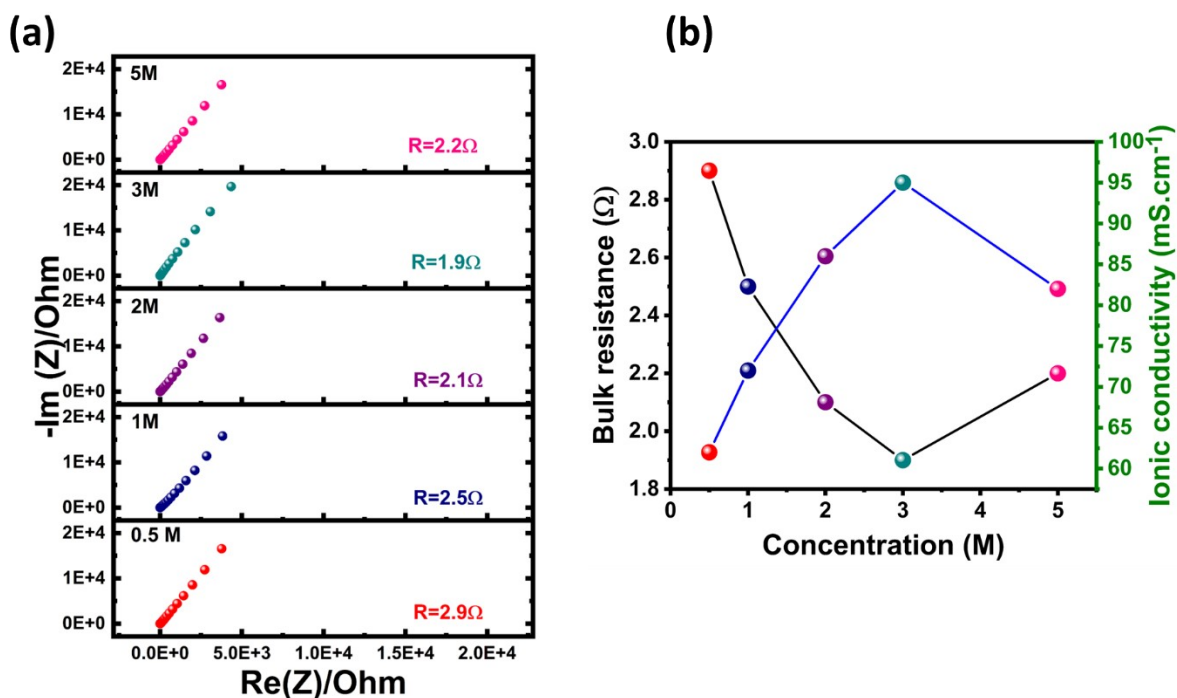
### Electronic Supplementary Information

## Novel Self-Regenerative and Non-Flammable High-Performance Hydrogel Electrolyte with Anti-Freeze Properties and Intrinsic Redox Activity for Energy Storage Applications

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**Figure S1.** (a) shows the impedance measurements for different concentrations from LiBr@PVA electrolyte, and (b) the relation between the resistance, ionic conductivity and the concentration.

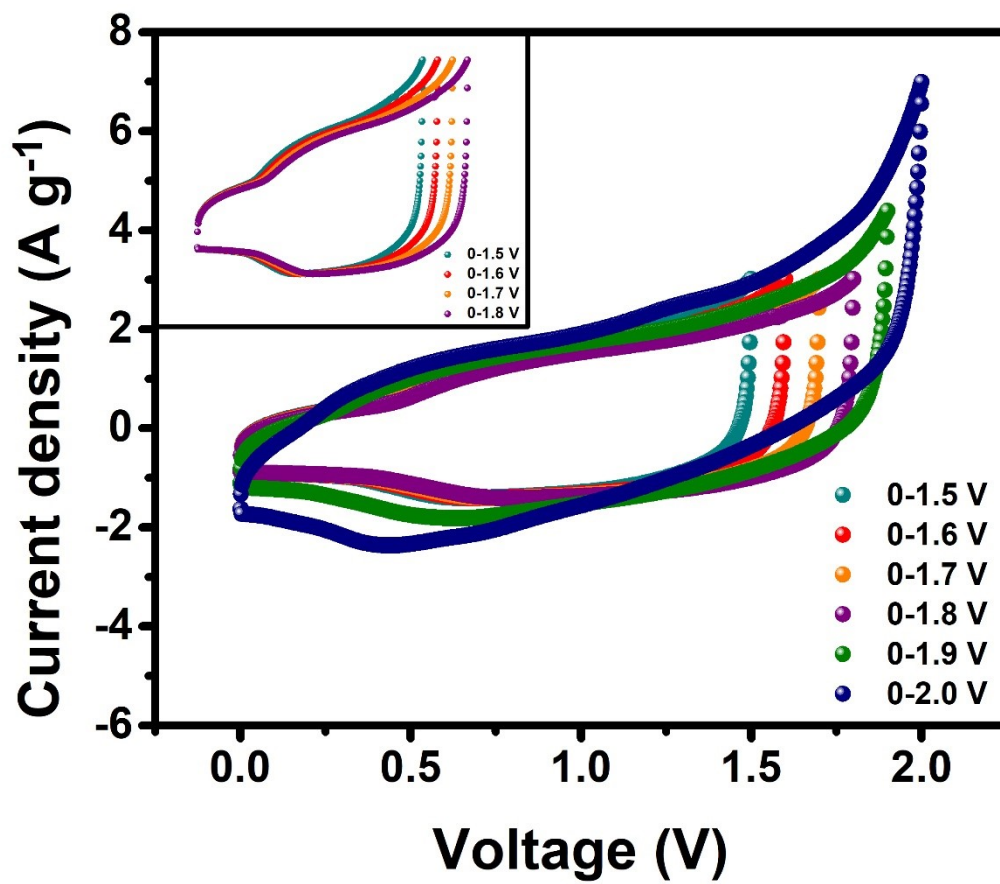
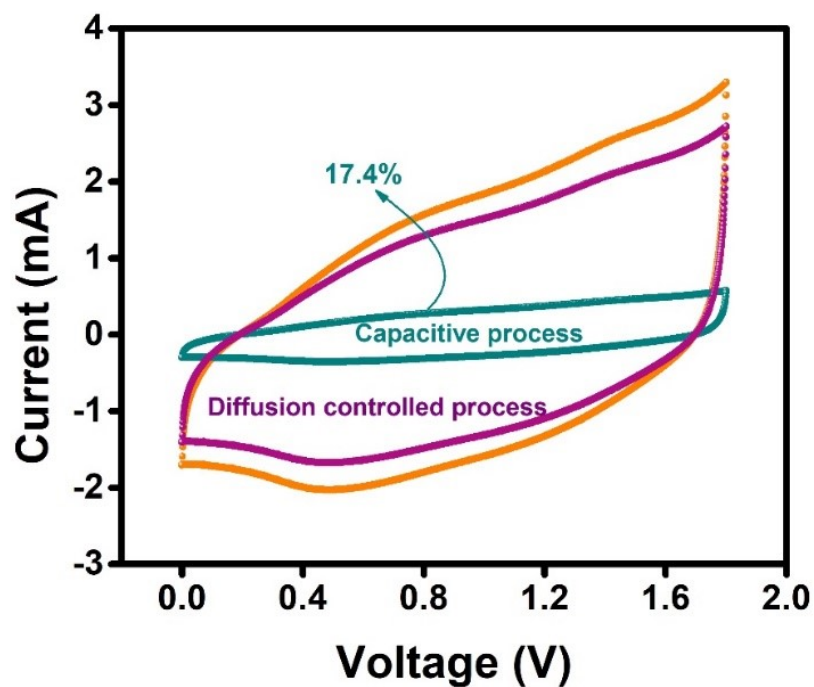
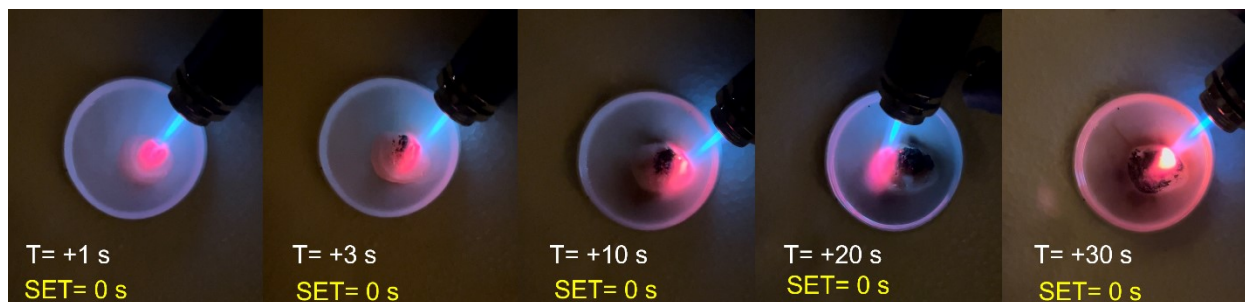


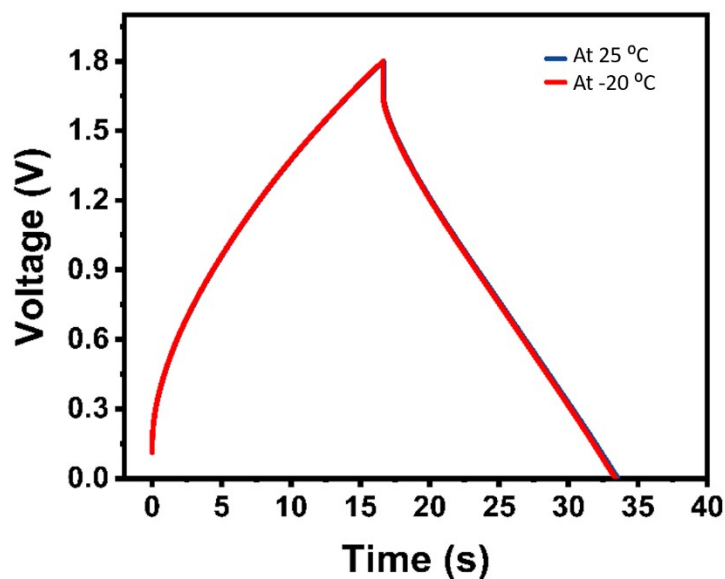
Figure S2. CVs different potential windows.



**Figure S3.** Dunn's theoretical calculations for LiBr @PVA at a moderate scan rate of 20 mV/s.



**Figure S4.** The self-extinguishing time (SET) for the flammability test of LiBr@ PVA hydrogel electrolyte.



**Figure S5.** GCD response of the C/3-LiBr@PVAM/C device at room temperature and at - 20 °C.

**Table S1.** Comparison between the energy density of our device to the redox electrolytes-based devices reported in the literature.

Device ( electrode-electrolyte)	Energy Density (Wh/Kg)	References
This Work (AC- LiBr@PVA)	20.5	This work
AC/Reline + 1% Water	18	<a href="https://doi.org/10.1039/D1EE02920G">https://doi.org/10.1039/D1EE02920G</a>
AC- PVA/H <sub>2</sub> SO <sub>4</sub> /Na <sub>2</sub> MoO <sub>4</sub>	14.4	<a href="https://doi.org/10.1021/am402162b">https://doi.org/10.1021/am402162b</a>
AC-PVA/H <sub>2</sub> SO <sub>4</sub> /P-benzenediol	11.31	<a href="https://doi.org/10.1016/j.jpowsour.2011.09.110">https://doi.org/10.1016/j.jpowsour.2011.09.110</a>
AC-PVA/H <sub>2</sub> SO <sub>4</sub> /indigo carmine	13.26	<a href="https://doi.org/10.1039/C4TA06322H">https://doi.org/10.1039/C4TA06322H</a>
AC-PVA/H <sub>2</sub> SO <sub>4</sub> /hydroquinone	20	<a href="https://doi.org/10.1039/C2RA21387G">https://doi.org/10.1039/C2RA21387G</a>