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


# Supporting Information

# A Universal and Facile Approach to Suppress Dendrite Formation for Zn and Li Metal Anode

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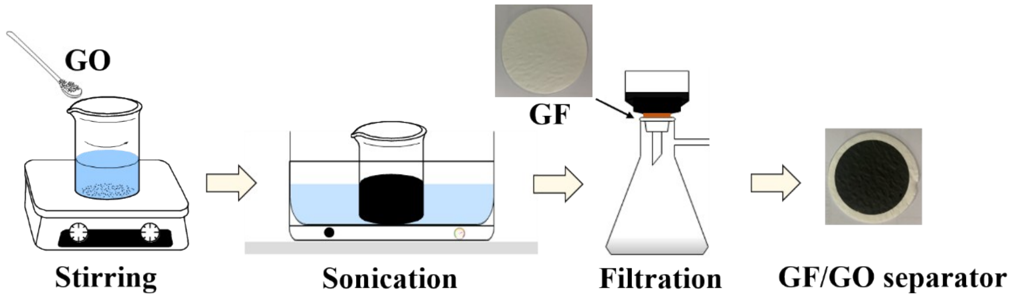


**Scheme. S1** Schematic illustration of material fabrication processes.

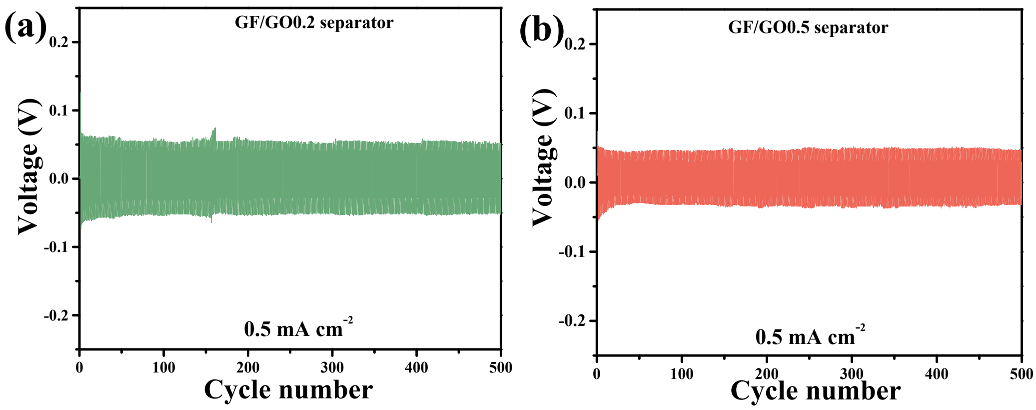


**Fig. S1** Voltage profiles of galvanostatic Zn plating/stripping for different separator, (a) GF/GO0.2 separator and (b) GF/GO0.5 separator.

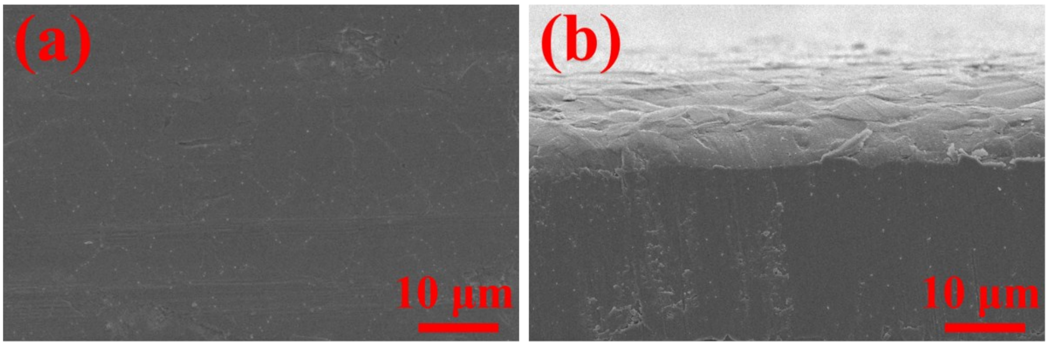


**Fig. S2** Surface images of pristine Zn foil.

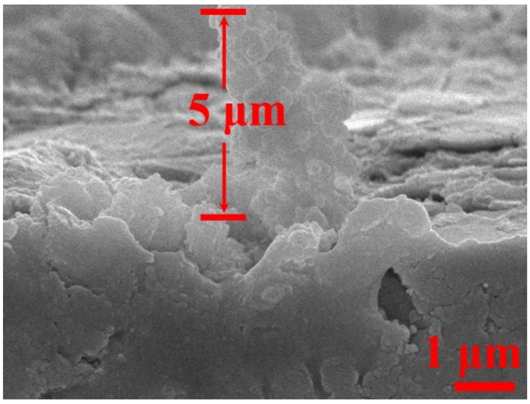


**Fig. S3** SEM images of the Zn dendrites in GF separator at 2 mA $cm^{-2}$.

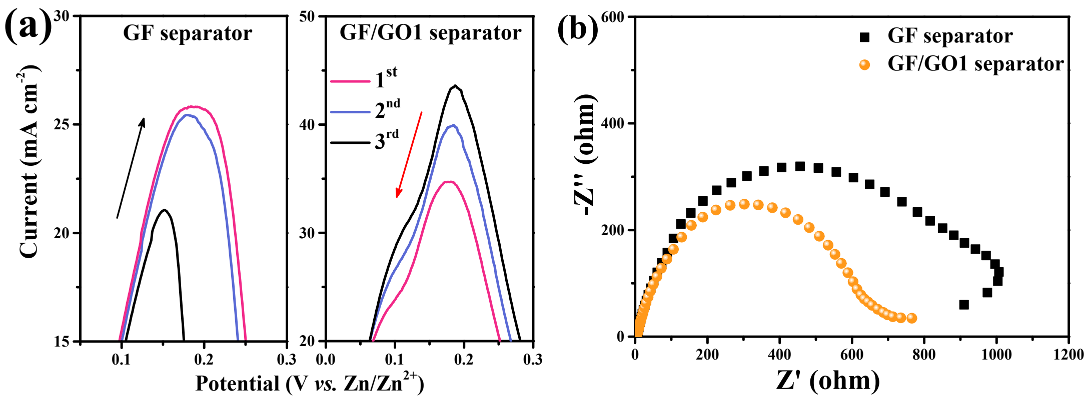


**Fig. S4** (a) The oxidation profiles of the zinc-titanium half-batteries (left) with the GF separator and (right) the GF/GO1 separator between 0 and 0.3 V (*vs* $Zn/Zn^{2+}$); (b) EIS plots of zinc-titanium half-batteries using the GF/GO1 and GF separator.

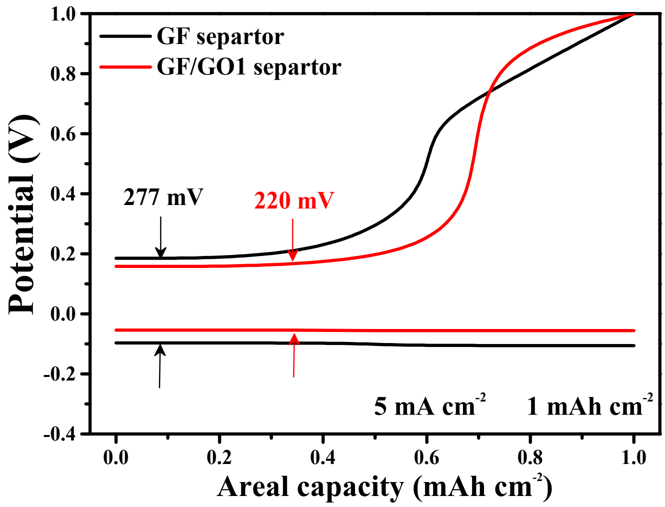


**Fig. S5** Voltage profiles of the initial Zn plating on Ti foil in zinc-titanium half-batteries with the GF separator and the GF/GO1 separator at 5 mA $cm^{-2}$.

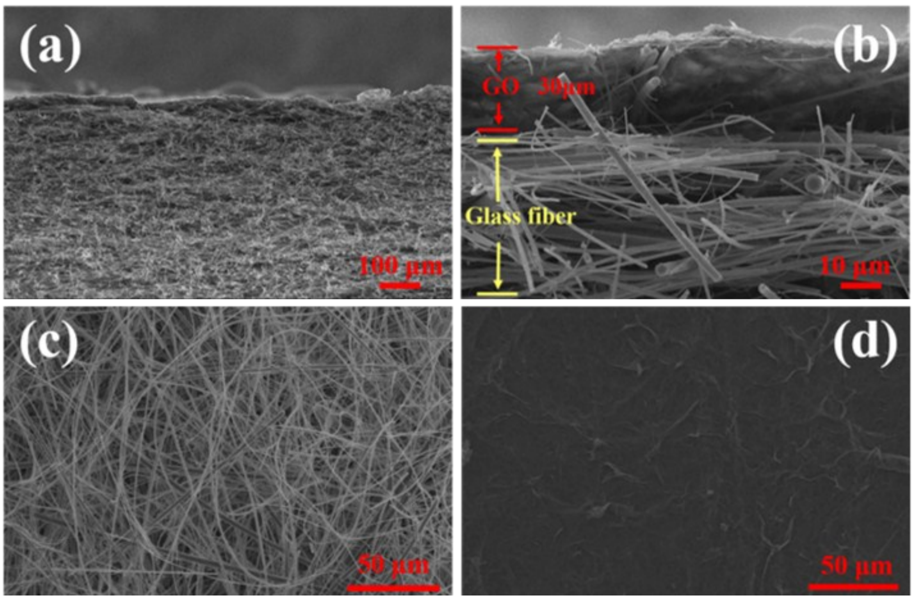


**Fig. S6** SEM images of GF/GO1 separator (a) (b); GF (c) and GO (d).

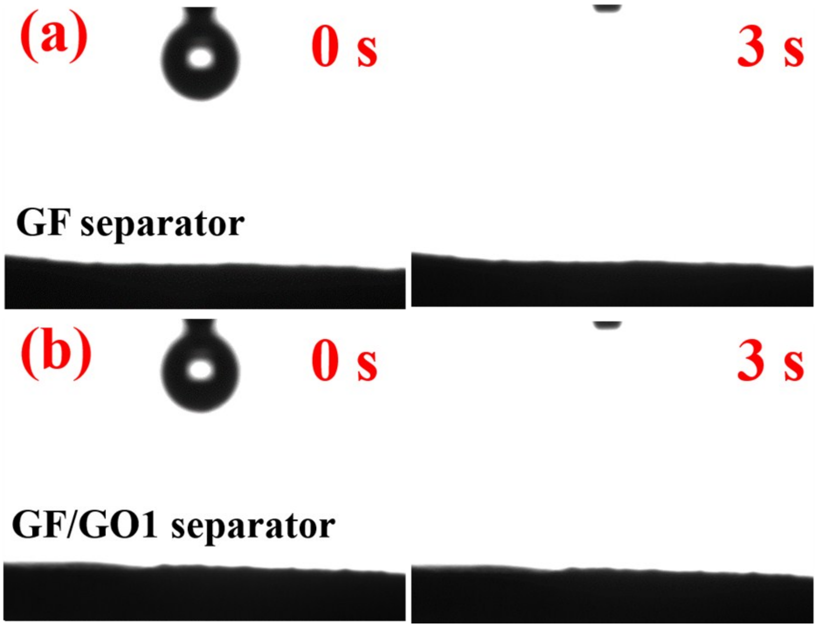


**Fig. S7** Wettability test of GF (a) and GF/GO1 (b) separator.

**Table. S1** Porosity and electrolyte uptake of GF and GF/GO separator.

| Sample | Porosity (%) | Electrolyte uptake (%) |
|---|---|---|
| GF separator | 1232 | 13214 |
| GF/GO1 separator | 1473 | 15891 |

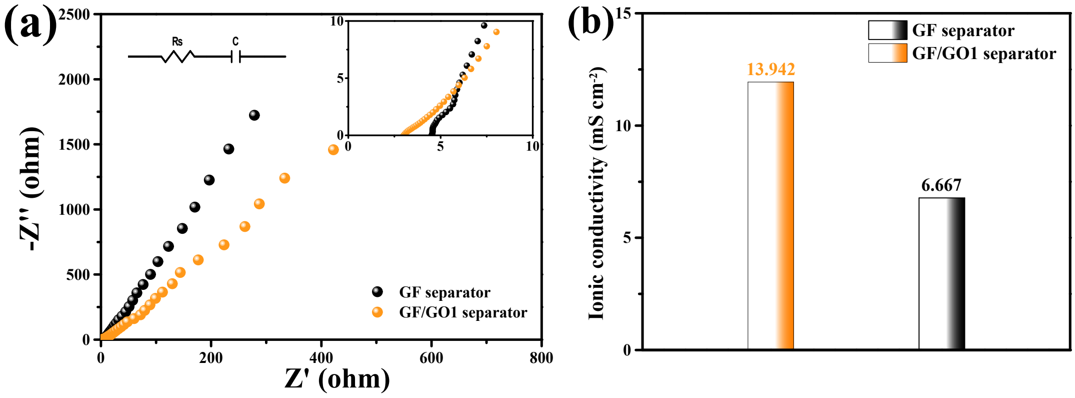


**Fig. S8** (a) The Nyquist plots of the GF and GF/GO1 separator at room temperature; (b) The ionic conductivity of GF and GF/GO1 separator.

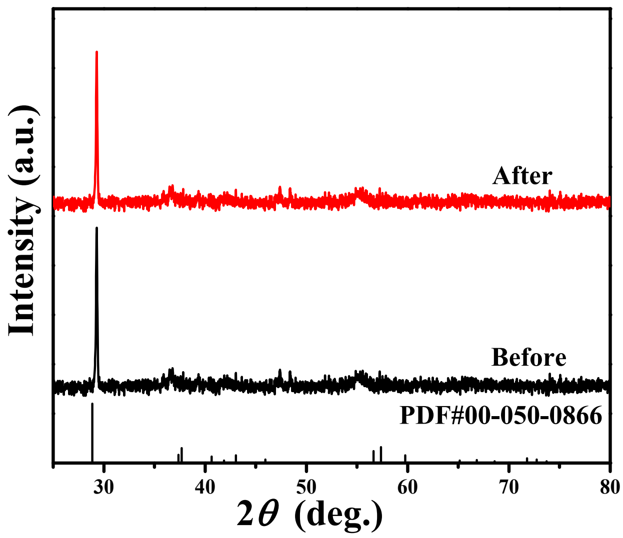


**Fig. S9** XRD patterns of prepared $MnO_2$ cathode material before and after ball milling.

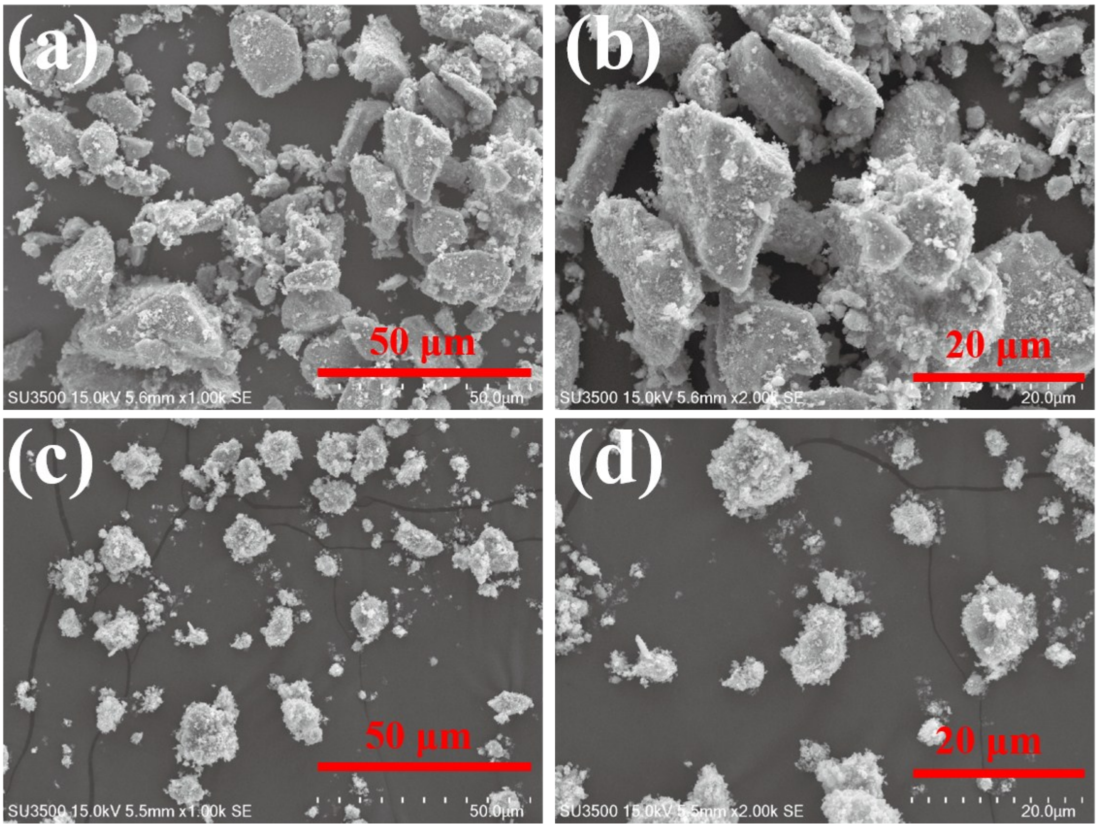


**Fig. S10** SEM images of $MnO_2$ before (a-b) and after (c-d) ball milling.

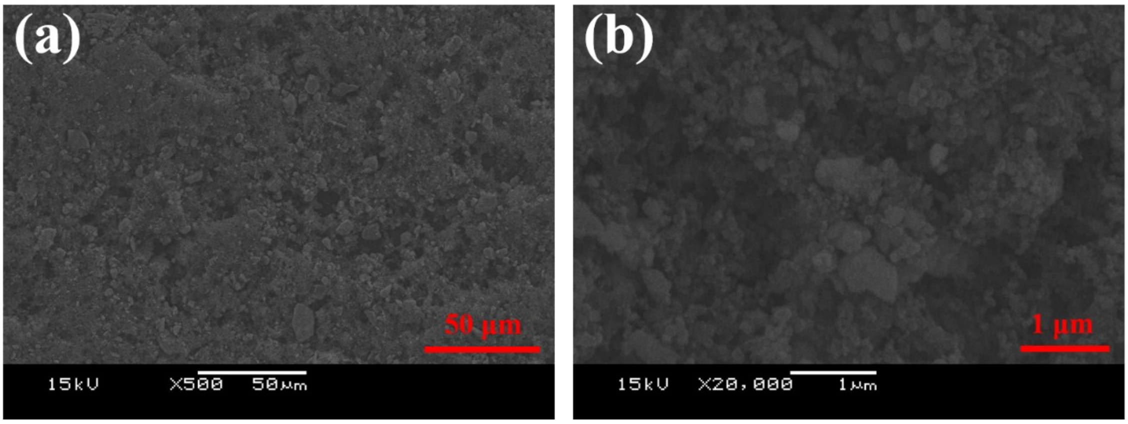


**Fig. S11** SEM images of $MnO_2$ (a) and (b) after coating.

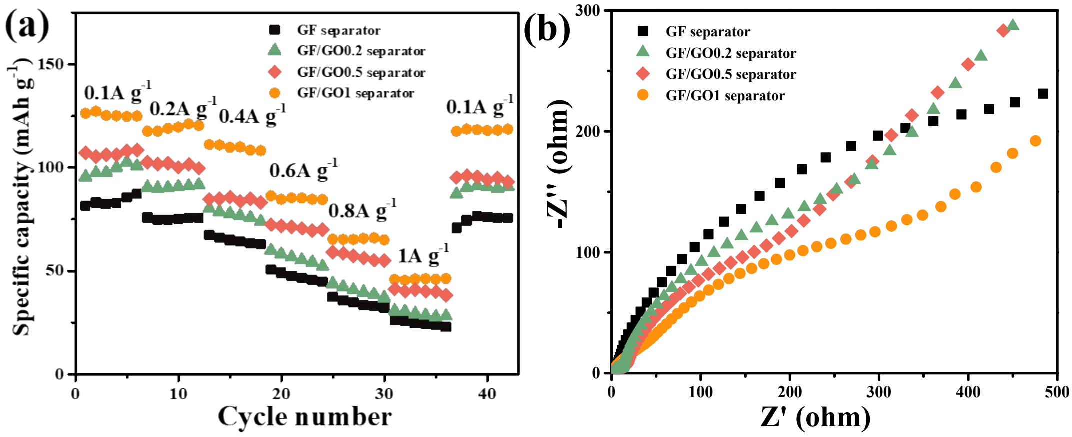


**Fig. S12** (a) Rate performances and (b) the electrochemical impedance spectra of Zn/$MnO_2$ cells using different separators.

**Table. S2** The $R_s$, $R_{sf}$ and $R_{ct}$ of the Zn-symmetric batteries and Zn//$MnO_2$ batteries with different separator.

| Zn-symmetric batteries | $R_s$ (Ω) | $R_{sf}$ (Ω) | $R_{ct}$ (Ω) |
|---|---|---|---|
| GF separator | 6.084 | 83.158 | 2733 |
| GF/GO1 separator | 4.513 | 21.918 | 657.3 |

| Zn//$MnO_2$ batteries | $R_s$ (Ω) | $R_{sf}$ (Ω) | $R_{ct}$ (Ω) |
|---|---|---|---|
| GF separator | 5.812 | 11.821 | 565.2 |
| GF/GO1 separator | 3.419 | 7.133 | 305.9 |

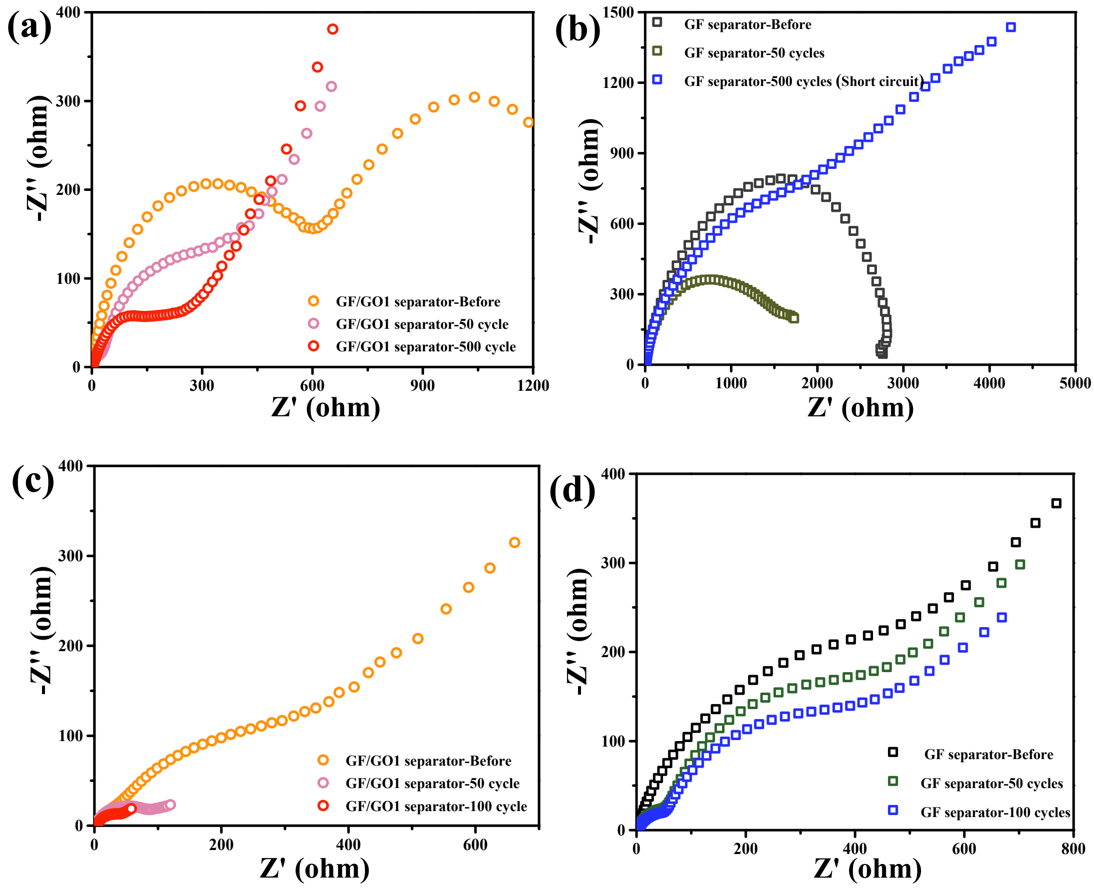


**Fig. S13** Electrochemical impedance spectra of (a) Zn-symmetric batteries with GF/GO1 separator and (b) GF separator after cycling; Electrochemical impedance spectra of (c) Zn/$MnO_2$ full batteries GF/GO1 separator and (d) GF separator after cycling.

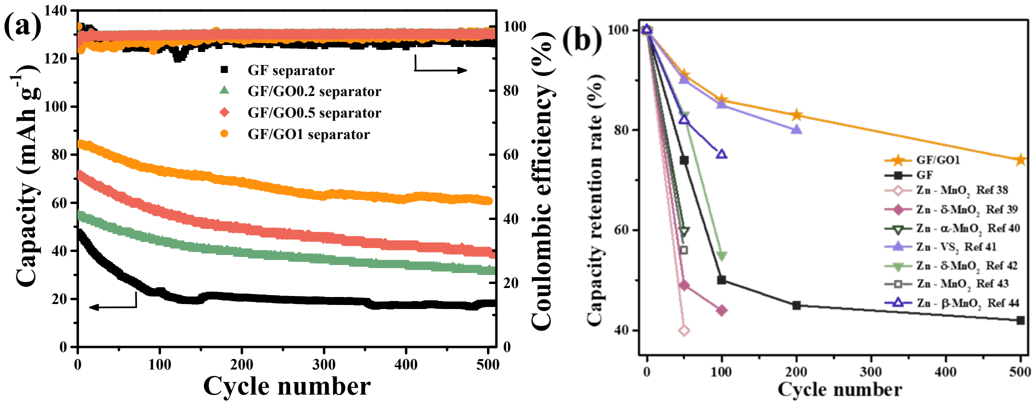


**Fig. S14** (a) Cycling performance of the Zn/$MnO_2$ full batteries using different separators at a current density of 0.5 A $g^{-1}$ and (b) the capacity retention rate of other zinc ion batteries using different cathode materials after cycles.

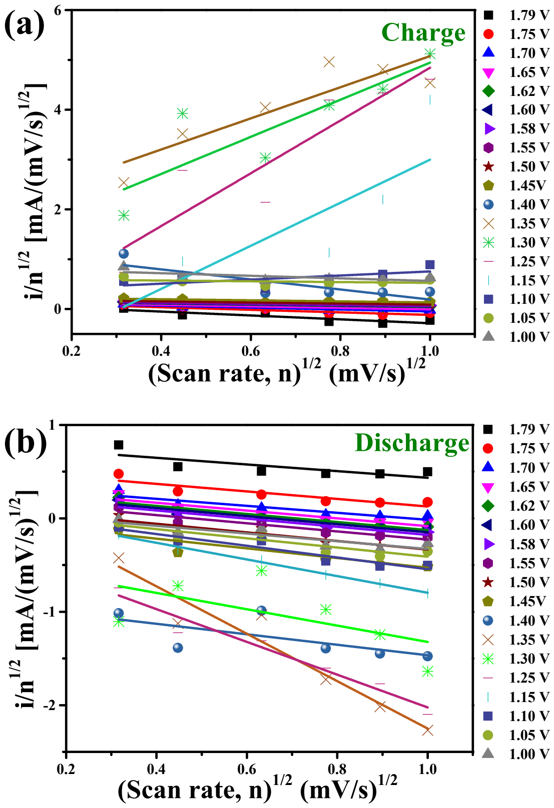


**Fig. S15** $i(v)/v^{1/2}$–$v^{1/2}$ plot in different voltage of GF/GO1 separator $Zn/MnO_2$ cell in (a) charge and (b) discharge.

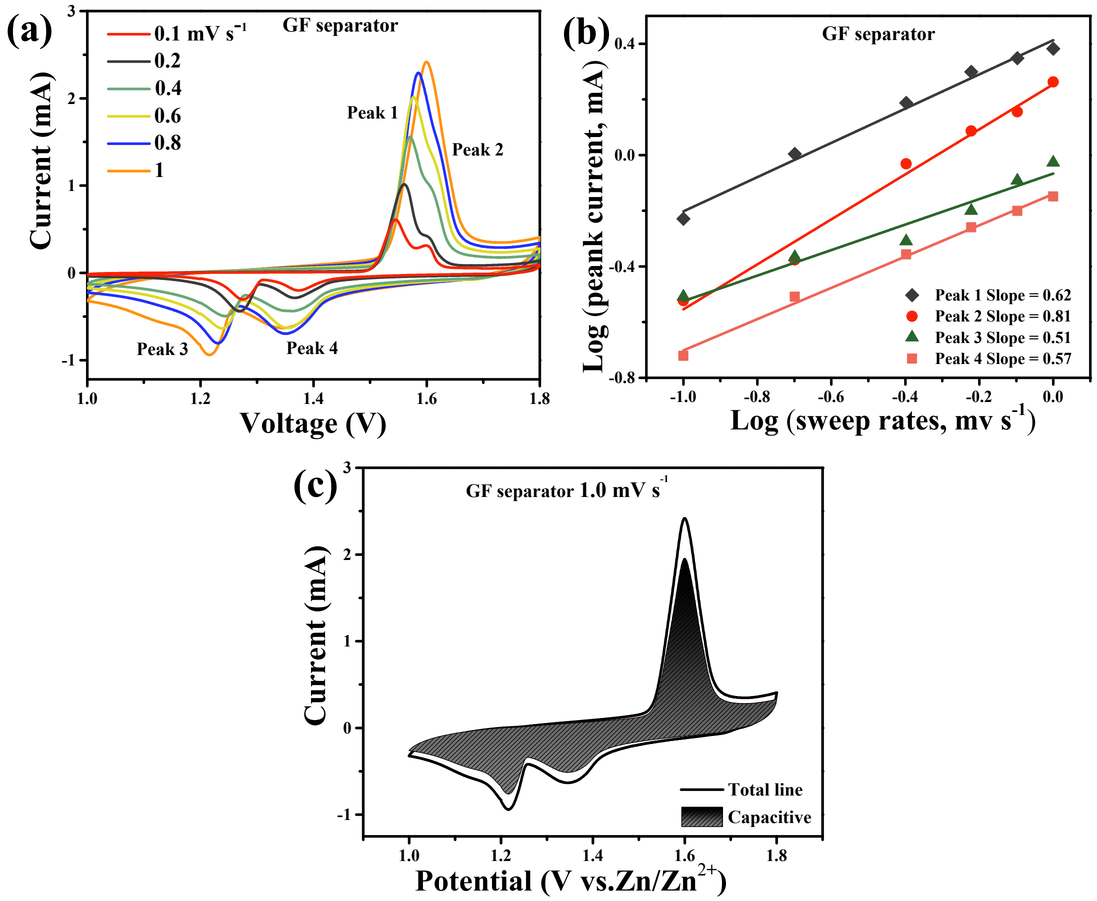


**Fig. S16**(a) CV curves of GF separator Zn/$MnO_2$ cell at different scan rate; (b) b values of GF separator $MnO_2$/Zn cell at di□erent peaks, calculated based on multi-rate CV results; (c) Capacitive charge storage contribution at the scan rate of 1.0 mV $s^{-1}$.

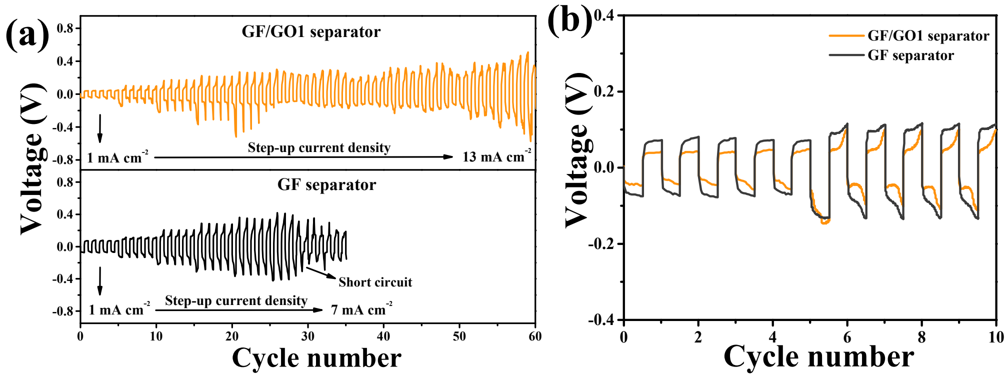


**Fig. S17** (a) Voltage profiles of different Li-symmetric cells with GF/GO1 separator and GF separator during Li plating/stripping using step-up current densities; (b) Voltage profiles in first ten cycles.