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

Supporting information

Impact of hydrogel microstructure and mechanics on dendrite growth for flexible long-life zinc-ion battery

Yang Yang, Huanlin Lyu, Qiuhong Wang, Faheem Mushtaq, Xian Xie, Fei Liu, Xiangkun Bo, Weilu Li, and Walid A. Daoud*

Department of Mechanical Engineering, City University of Hong Kong, Tat Chee Avenue, Kowloon, Hong Kong, China

*Corresponding author: wdaoud@cityu.edu.hk

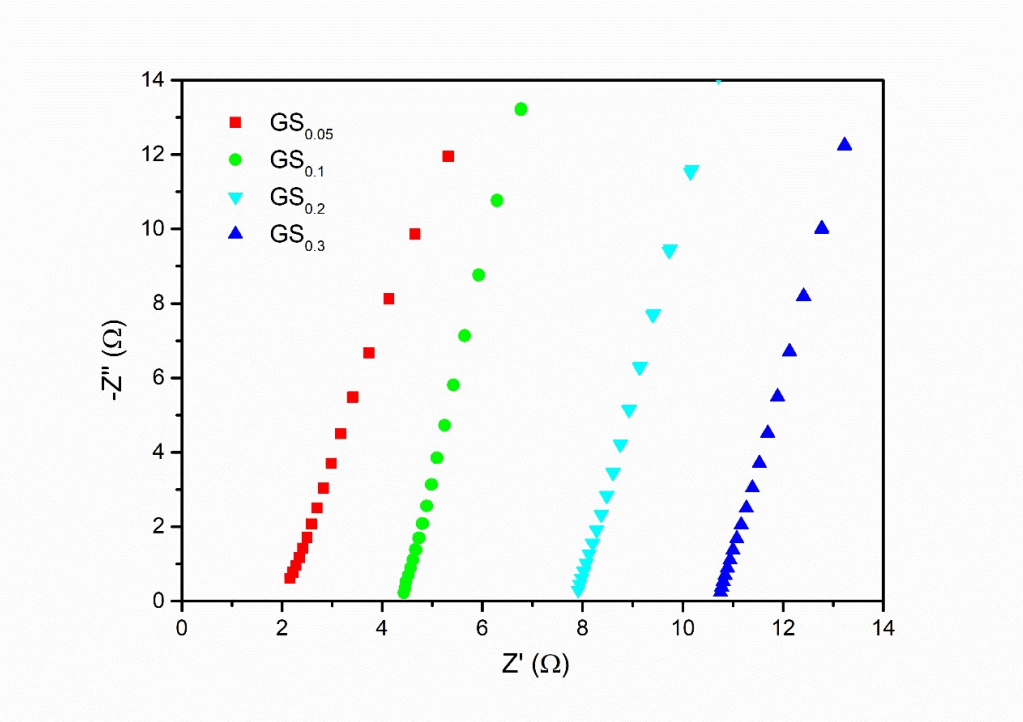

Figure S1 Nyquist plots of $GSx_{(x=0.05\text{-}0.3)}$ electrolyte, measured in a Zn// electrolyte// Zn configuration.

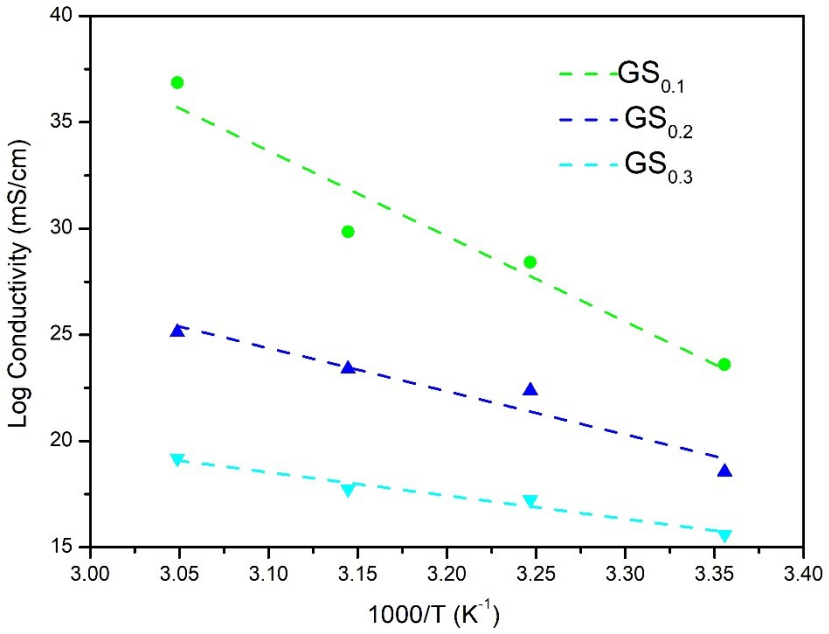

Figure S2 Arrhenius plots of $GSx_{(x=0.1\text{-}0.3)}$ electrolyte, measured in a Zn// electrolyte// Zn configuration.

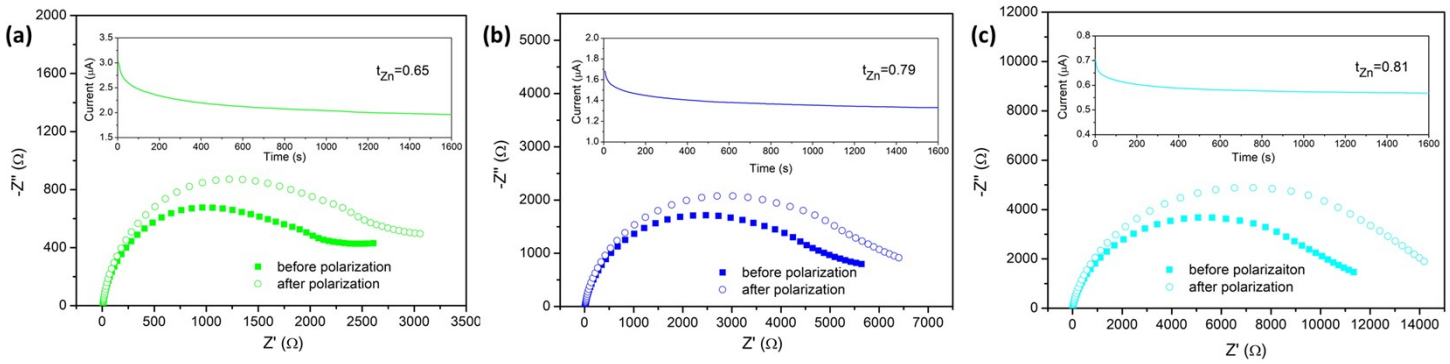

Fig S3 Impedance spectra of symmetric cells with (a)$GS_{0.1}$, (b) $GS_{0.2}$ and (c) $GS_{0.3}$ before and after polarization. The insets show the corresponding current-time curves.

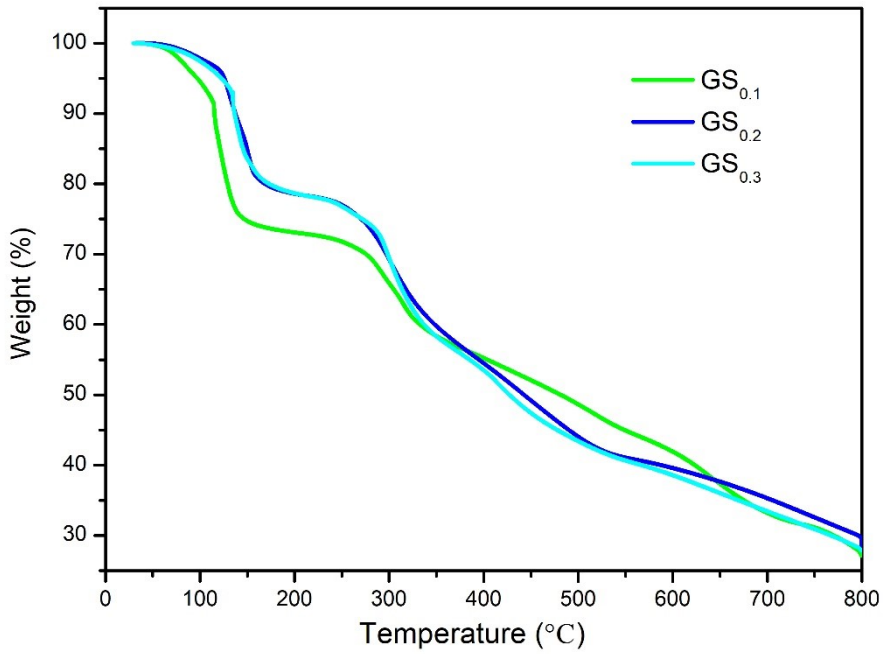

Fig S4 TGA curves of $GS_{0.1\text{-}0.3}$. The initial weight loss in all samples at 90-150°C is attributed to the loss of water. Above that, the slight weight loss in the temperature window of 150-270°C is attributed to the loss of crystalline water of zinc sulfate hydrate. At 270-500°C, the weight loss is attributed to the degradation of gelatin.[R1]

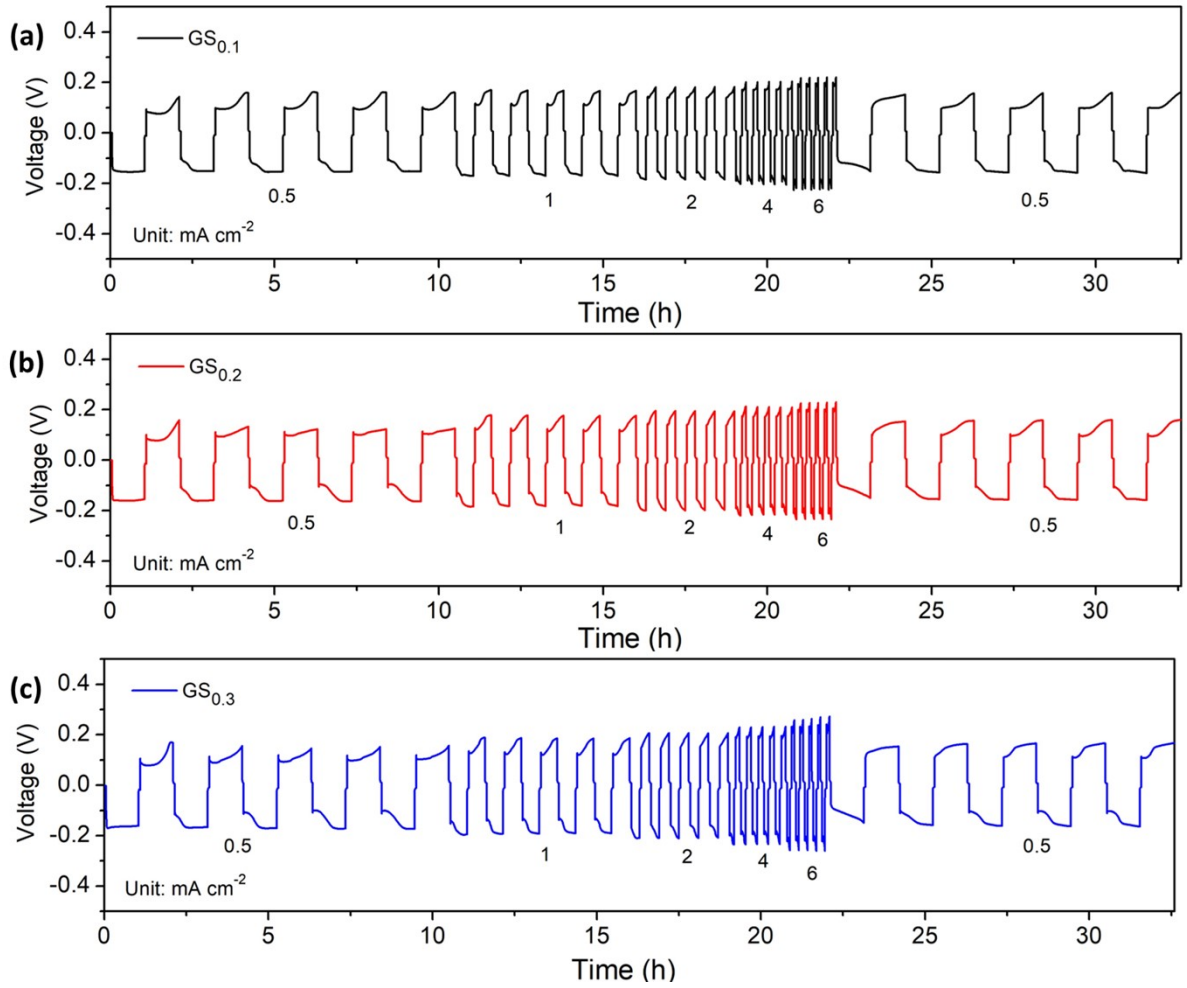

Fig S5 Rate performance of the symmetric cells with (a)$GS_{0.1}$, (b)$GS_{0.2}$ and (c)$GS_{0.3}$ electrolyte.

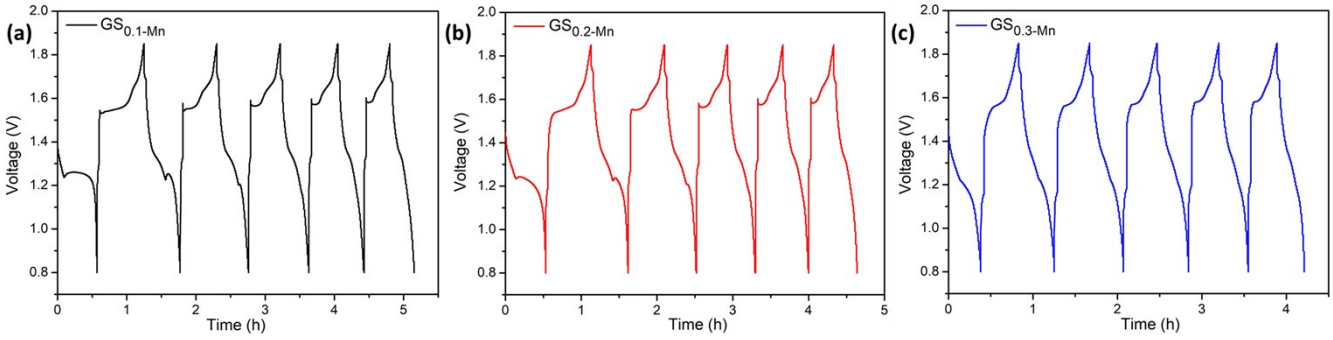

Fig S6 Galvanostatic voltage profiles of Zn-MnO_2 full-cell batteries with (a) $GS_{0.1}$, (b) $GS_{0.2}$, and (c) $GS_{0.3}$ at 0.5 A g^{-1}. At the current density of 0.5 A g^{-1}, the full-cell batteries based on $GS_{0.1\text{-}0.3}$ in 0.2 M $MnSO_4$ show a capacity of 321.5 mAh g^{-1}, 281.6 mAh g^{-1} and 205.5 mAh g^{-1}, respectively.

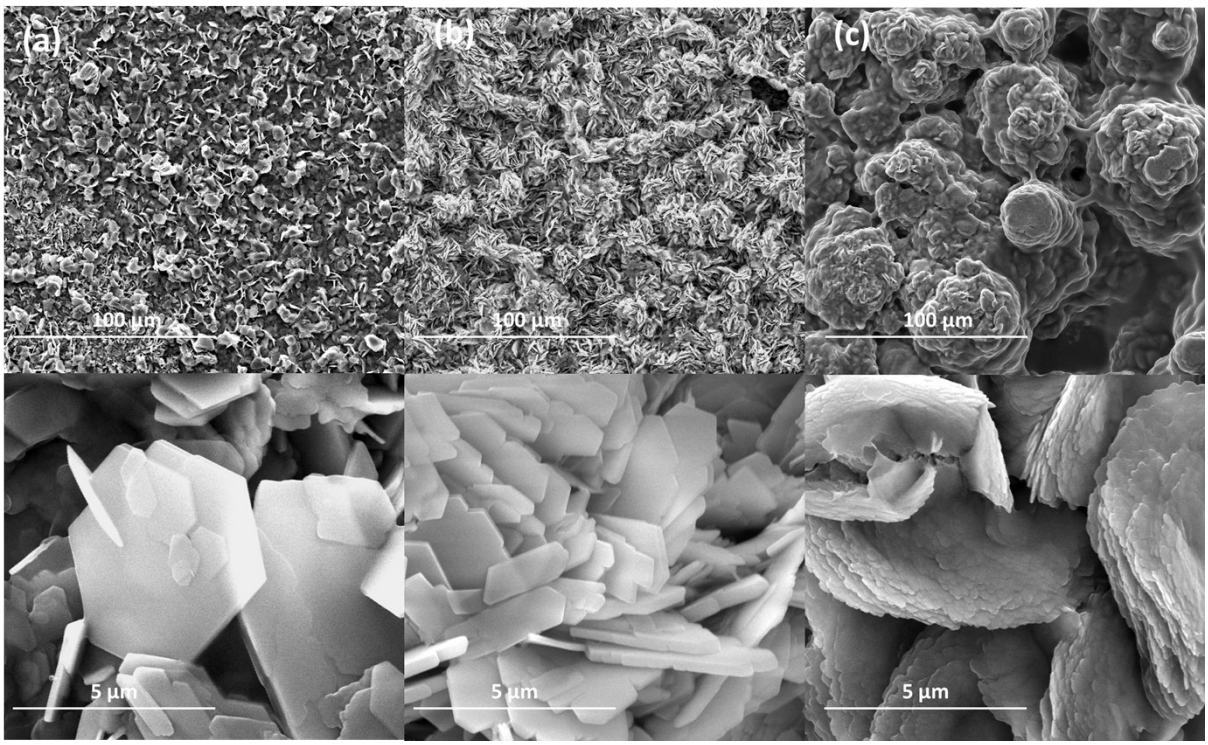

Figure S7 Surface morphology of zinc electrodes after 400 cycles in symmetric cells with (a) $GS_{0.1}$, (b) $GS_{0.2}$ and (c) $GS_{0.3}$.

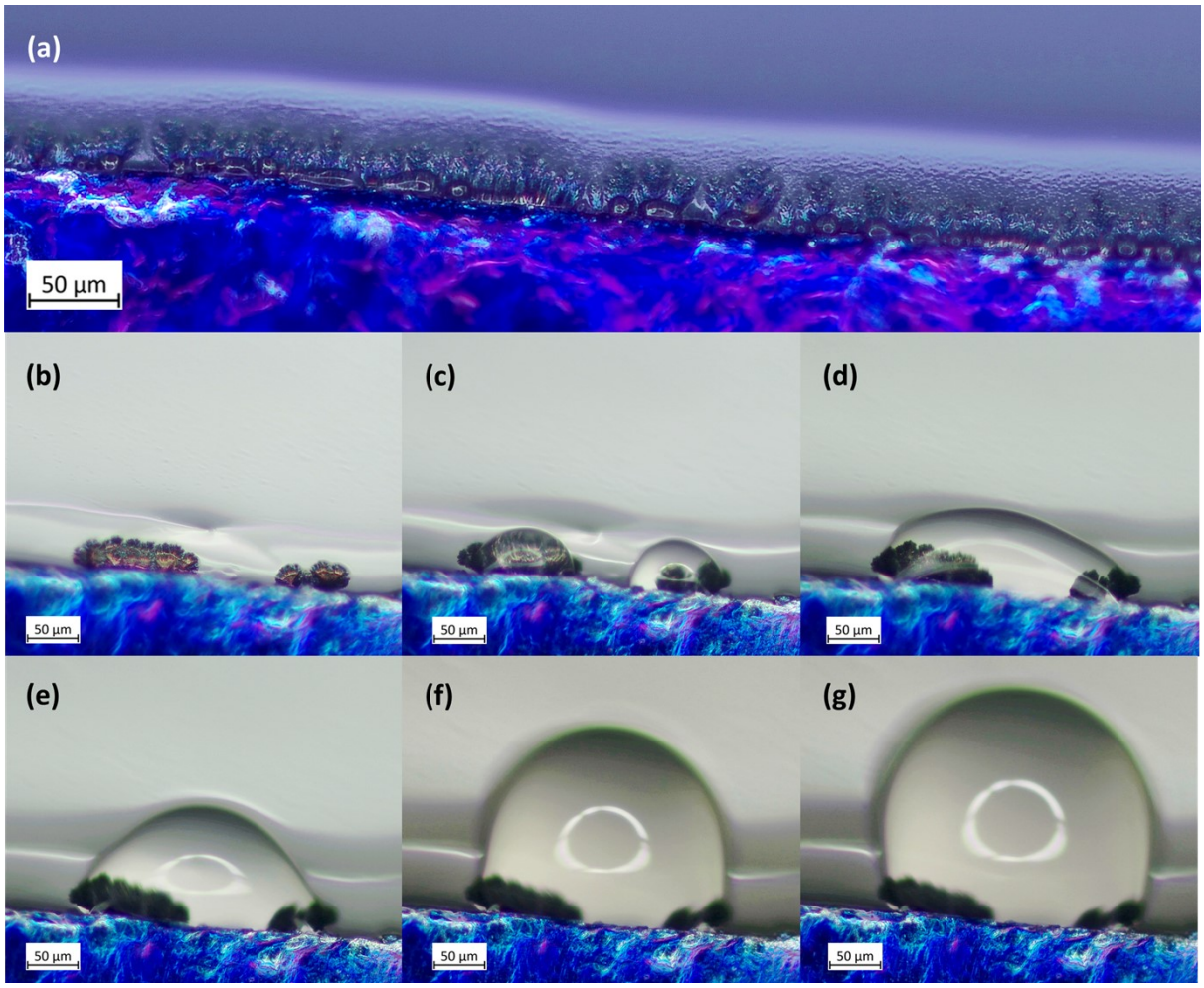

Figure S8 OM images of (a) water bubble generation in $GX_{0.3}$; (b-g) water bubble evolution in $GX_{0.2}$, at 4 mA cm^{-2}, during the 15-minute discharge process.

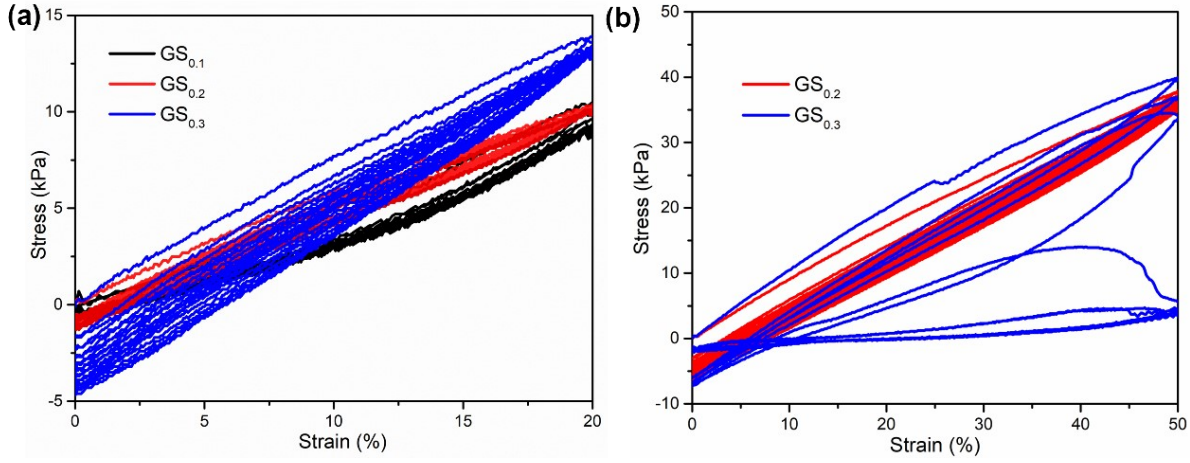

Figure S9 Ten consecutive loading-unloading tensile cycles of: (a) $GS_{0.1\text{-}0.3}$ hydrogel under 20% strain; (b) $GS_{0.2,0.3}$ hydrogel under 50% strain.

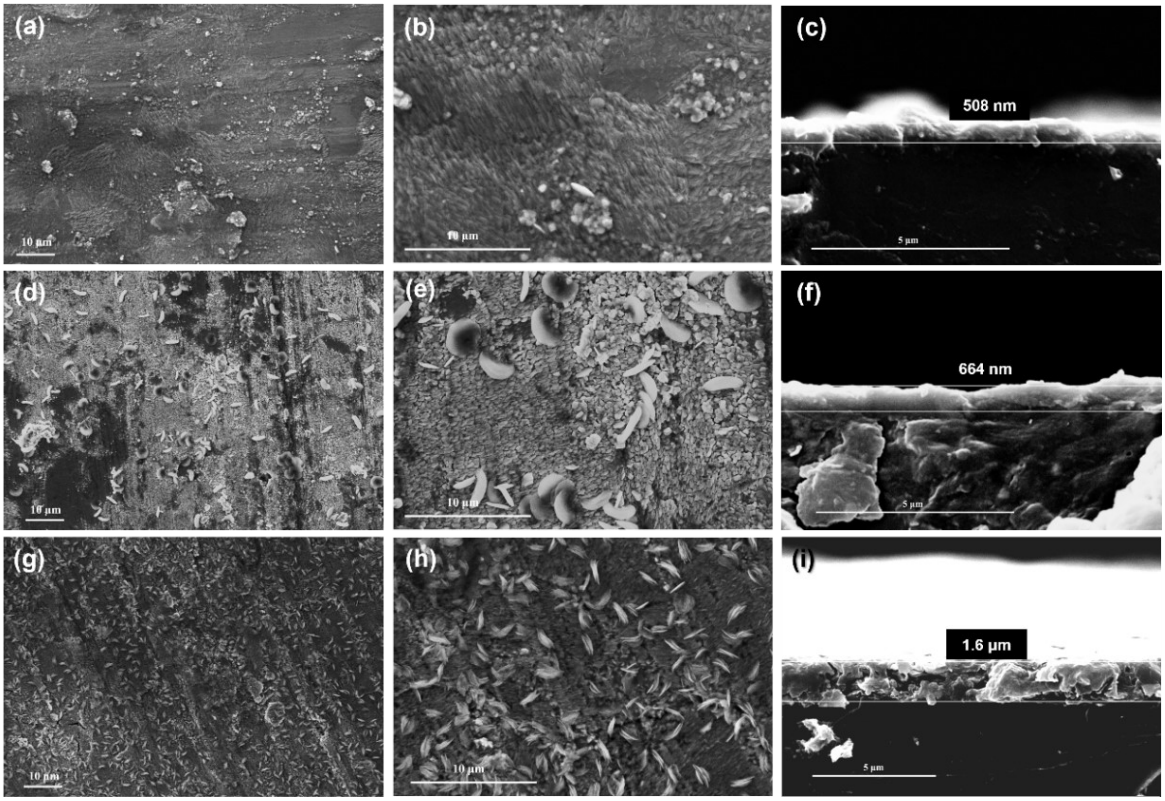

Figure S10 Morphology evolution of zinc electrode in GS0.2 after plating/stripping for 1 cycle at different current densities: (a, d, g) top-view of zinc electrodes cycled at 0.5, 1.0 and 2.0 mA cm-2; (b, e, h) microstructure of zinc layer of (a, d, g); (c, f, i) cross-section of (a, d, g).

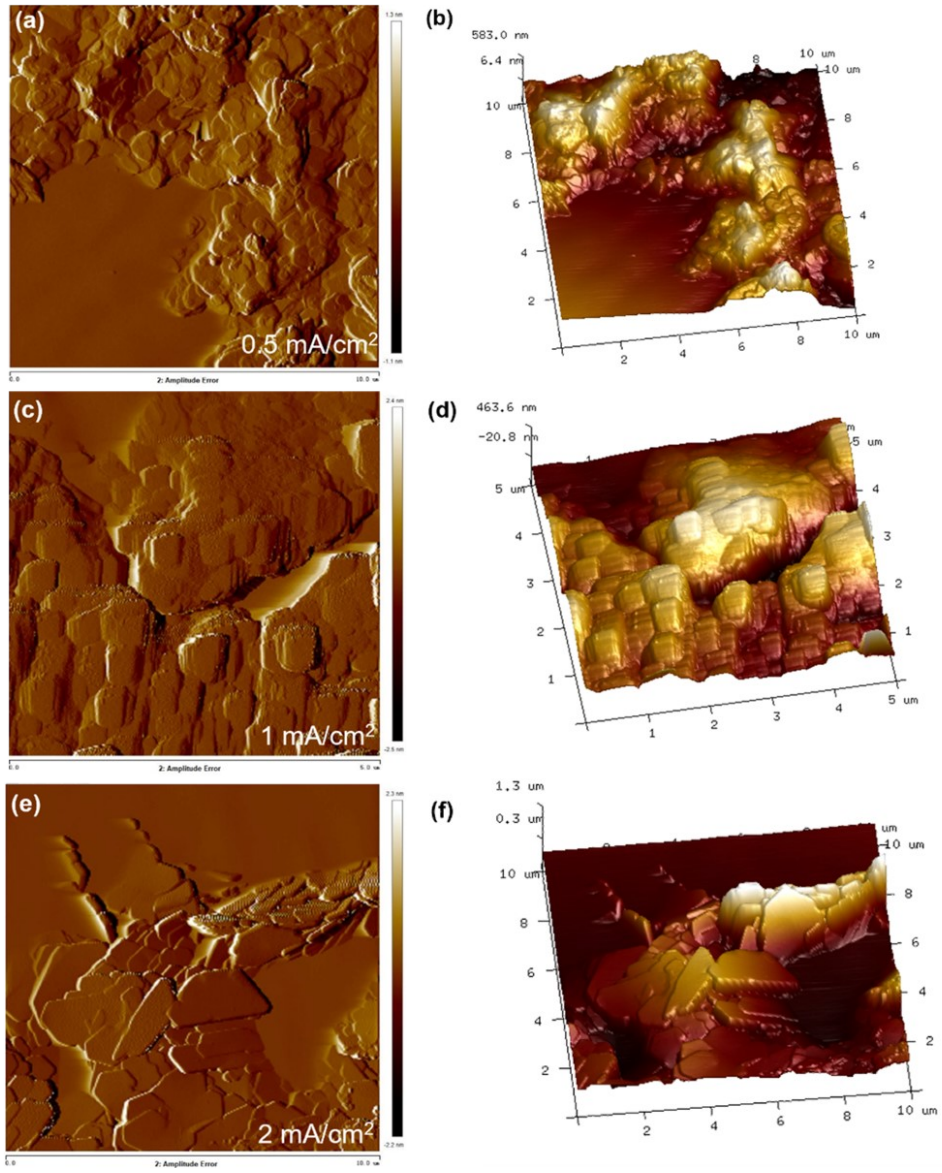

Fig S11 AFM images of zinc electrodes cycled at different current densities of 0.5 mA cm^{-2} (a, b), 1.0 mA cm^{-2} (c, d), 2.0 mA cm^{-2} (e, f), plating/stripping capacity is 0.5 mAh cm^{-2}.

Reference:

R1 D. Kotatha, M. Hirata, M. Ogino, S. Uchida, M. Ishikawa, T. Furuike and H. Tamura, *Journal of Nanotechnology*, 2019, **2019**.