Supplementary Material

Materials and Structure Design for Solid-State Zinc-Ion Batteries: A Mini-Review

Evan Hansen1, Jian Liu1\*

1School of Engineering, Faculty of Applied Science, the University of British Columbia, Kelowna, B.C., Canada

**\* Correspondence:**Jian Liu  
[Jian.liu@ubc.ca](mailto:Jian.liu@ubc.ca)

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**Supplementary Figure 1** – Schematics of (a) gel polymer electrolyte (GPE) and (b) solid polymer electrolyte (SPE) structures.

**Supplementary Table-1** Summary of gel polymer electrolytes (GPEs) and solid polymer electrolytes (SPEs) for solid-state Zn-ion batteries (SSZIBs).

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Type | Polymer | Salt | Plasticizer | Ionic Conductivity (mS cm-1 at RT or 30 °C) | Characteristics | Ref. |
| GPE | PAM | ZnSO4/MnSO­4 | Water | 17.3 | Flexible, stretchable | [1, 2] |
|  | Alginate/PAM | ZnSO4/MnSO4 | Water | 43.2 | Flexible, stretchable, tough, compressible | [3] |
|  | gelatine-g-PAM/PAN | ZnSO4/MnSO4 | Water | 17.6 | Flexible, combined separator/electrolyte | [4] |
|  | PAN-S | ZnSO4 | Water | 3.32 | Combined separator/electrolyte, dendrite suppression | [5] |
|  | PEO/PVdF | Zn(CF3SO3)2 | DMF/EMIMTFSI | 0.163 | Combined separator/electrolyte | [6] |
|  | PEO/PVdF | Zn(CF3SO3)2 | DMF | 0.025 | Combined separator/electrolyte | [7] |
|  | PEO-PPO-PEO | Li2SO4/ZnSO4 | Water | 6.33 | Flexible, dendrite and side-reaction suppression, self-healing electrode/electrolyte interface | [8] |
|  | PEGDGE | Zn(CF3SO3)2 | PC | 0.377 | Flexible, high thermal and electrochemical stability, side-reaction suppression and anti-aging | [9] |
|  | PVdF-HFP/PEO | Zn(BF4)2 | EMIM BF4 | 16.9 | Flexible, tough, combined separator/electrolyte, high thermal stability, dendrite and side-reaction suppression | [10] |
|  | PVA | Zn(CF3SO3)2 | Water | 12.6 | Flexible, self-healing | [11] |
|  | PVA | KCl/Zn(CH3COO)2 | Water | - | Flexible, combined separator/electrolyte, chromatic short-circuit warning | [12] |
|  | PVA | LiCl/ZnCl2/MnSO4 | Water | - | Flexible, dendrite and side-reaction suppression | [13] |
|  | PVA | Zn(CF3SO3)2/MnCl2 | Water | - | Flexible | [14] |
|  | PVA | LiCl/ZnCl2 | Water | - | Flexible | [14] |
|  | PVC/PEMA | Zn(CF3SO3)2 | DMF/EMIMTFSI | 0.110 | Flexible, combined separator/electrolyte | [15, 16] |
|  | PVC/PEMA with SiO2 nanofiller | Zn(CF3SO3)2 | DMF/EMIMTFSI | 0.671 | Flexible | [17] |
|  | PVdF-HFP | Zn(TFSI)2 | EC/PEGDME | 0.47 | - | [18] |
|  | PVdF-HFP | Zn(TFSI)2 | EMITFSI | 1.05 | Flexible, high thermal stability | [19] |
|  | PVdF-HFP | Zn(CF3SO3)2 | EMITF | 1.31 | Flexible, high thermal stability | [19] |
|  | PVdF-HFP with ZnO nanofiller | Zn(CF3SO3)2 | EC/PC | 6.70 | Combined separator/electrolyte | [20] |
|  | PVdF-HFP | ZN(CF3SO3)2 | NMP/EMIMTFSI | 3.82 | - | [21] |
|  | PVdF-HFP | ZN(CF3SO3)2 | NMP/EMIMTF | 7.07 | - | [21] |
|  | PVdF-HFP | ZN(CF3SO3)2 | THF/EMITF | 0.144 | Flexible | [22] |
|  | FS | ZnSO4/Na2SO4 | Boric Acid/Water | 8.1 | Flexible, dendrite suppression | [23] |
|  | FS | Li2SO4/ZnSO4 | PEG300/Water | - | Dendrite and side-reaction suppression | [24] |
|  | FS with Pyrazole additive | Li2SO4/ZnSO4 | Water | - | Dendrite and side-reaction suppression | [25] |
|  | PNA | ZnSO4/MnSO­4 | DMF/Water | - | Thermal smart protection (solid above 50˚C with low conductivity) | [26] |
|  | Gelatin | ZnSO4/Li2SO4 | Water | 6.15 | Flexible, compressible, tough, brittle, dendrite suppression | [27] |
|  | EG-waPUA/PAM | ZnSO4/MnSO4 | Water | 16.8 | Flexible, stretchable, compressible, tough, combined separator/electrolyte, operational in sub-zero temps. | [28] |
|  | NFC/PAM | ZnSO4/MnSO4 | Water | 22.8 | Flexible, stretchable, tough | [29] |
|  | Xanthan Gum | ZnSO4/MnSO4 | Water | 16.5 | Flexible, combined separator/electrolyte, non-toxic, dendrite and side-reaction suppression | [30] |
|  | KCR | ZnSO4/MnSO4 | Water | 33.2 | Flexible, combined separator/electrolyte, non-toxic | [31] |
| SPE | PEO | ZnCl2 | N/A | ~3.00 x 10-6 | - | [32] |
|  | PEO | ZnBr2 | N/A | ~7.00 x 10-6 | - | [32] |
|  | PEO | ZnI2 | N/A | ~7.00 x 10-6 | - | [32] |
|  | PEOsynthesis by solution casting | Zn(CH3COO)2 | N/A | 1.55 x 10-3 | - | [33] |
|  | PEOsynthesis by hot-press casting | Zn(CH3COO)2 | N/A | 1.15 x 10-4 | - | [34] |
|  | PEO | Zn(CF3SO3)2 | N/A | 1.09 x 10-3 | - | [35] |
|  | PEO/PVdF | Zn(CF3SO3)2 | N/A | 0.025 | - | [7] |
|  | d-U(2000)60PEO | Zn(CF3SO3)2 | N/A | 2.70 x 10-3 | High thermal stability | [36] |
|  | PEO/PPG with Al2O3 nanofiller | Zn(CF3SO3)2 | N/A | 0.210 | High thermal and electrochemical stability | [37] |
|  | Crosslinked PEO with TiO2 nanofiller | ZnCl2 | N/A | ~1 | High thermal stability | [38] |
|  | PEO with BANFs | Zn(CF3SO3)2 | N/A | 2.5 x 10-2 | Flexible, tough, compressible, dendrite suppression | [39] |
|  | PVdF-HFP | Zn(CF3SO3)2 | N/A | 0.0244 | Flexible, high thermal and electrochemical stability, dendrite suppression | [40] |
|  | PVdF-HFP with ZrO2 nanofiller | ZrO2/Zn(CF3SO3­)2 | N/A | 0.46 | High thermal and electrochemical stability | [41] |
|  | PVdF-HFP with TiO2 nanofiller | Zn(CF3SO3­)2 | N/A | 0.34 | - | [42] |
|  | PVC/PEMA | Zn(CF3SO3­)2 | N/A | 2.79 x 10-3 | - | [15] |
|  | ZnMOF-808 | ZrOCl2·8H2O | N/A | 0.21 | Dendrite suppression | [43, 44] |
|  | CMC | ZnSO4 | N/A | - | Flexible, coaxial arrangement | [45] |
|  | CMC/PniPAM20 | Zn(CF3SO3)2 | N/A | 0.168 | Flexible, tough, high thermal stability, dendrite suppression | [46] |

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