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Development of Hydrogel Electrolyte for Flexible Zinc-Air Batteries

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Abstract : Flexible zinc-air battery (FZAB) is very promising for wearable electronics with various merits, including high energy density, environmental friendliness, low cost and good safety. The FZABs are usually based on hydrogel electrolytes. However, the instability of zinc surface contact with alkaline hydrogel electrolyte, such as excessive ZnO formation, hinders the wide adopt of FZABs and is less studied. Another challenge of the hydrogel electrolyte is its limited ionic conductivity, which is more severe at a low temperature, limiting the application of FZABs in low-temperature environments. Therefore, we develop the regulated dual-network hydrogel with the addition of histidine, which tailors the hydrogel with amino and carboxyl groups, leading to high ionic conductivity, efficient ion transfer channels and anti-freezing properties. The imidazole group has synergistical engineering, which adjusts the adsorption of Zn^{2}+ on an alkaline zinc surface, leading to uniform deposition and reduction of ZnO, extending the working stability of FZAB. Both simulation and experimental analyses confirm the superiority of regulated hydrogel. The as-fabricated FZAB achieves a maximum power density of 117.8 mW cm^{-2} and can run 627 cycles, reaching 209 h. Meantime, the FZAB can reserve 76.8% working voltage at -20° C.

Keywords : electrolyte, hydrogel, zinc air batteries, energy storage
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