Polyacrylamide/PEDOT: PSS based Hydrogel as an Electrolyte for Aqueous Zinc Ion Battery Systems

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As demand for aqueous zinc-ion batteries (AZIBs) continues to rise, it's important to consider the drawbacks of their current electrolyte solution. AZIBs commonly use a zinc salt solution as an electrolyte and a cellulose or nylon paper as a separator, but this solution can leak or crystallize due to water evaporation, leading to decreased conductivity. However, hydrogel electrolytes [1] may offer a solution to this problem, with their high water-encapsulation and unique properties based on the polymer structure, such as stretchability, self-healing, and thermal sensitivity [2, 3]. It's crucial to develop environmentally friendly, safe, and low-cost electrolyte systems to enhance the potential of AZIBs for commercial use.

In this study, a polyacrylamide and poly (ethylene dioxythiophene): polystyrene (PEDOT: PSS) (PPP) based hydrogel electrolyte was successfully synthesized (Fig 1.a) and characterized. The results showed that adding PEDOT: PSS increased the polymer's water uptake and swelling ratio (Fig. 1.b), indicating better water encapsulation and stability of the polymer structure.
The SEM images (Fig. 1.d) revealed a porous structure with an average pore size of 2.15 µm, suitable for electrolyte and separator functions. Cyclic voltammetry (CV) (Fig. 1.c) was performed to assess the potential working window of the hydrogel electrolyte. The results showed that the PPP hydrogel-based electrolyte exhibited improved performance compared to other electrolytes, suppressing oxygen evolution with the enhanced electrochemical potential window up to 2.45V. The effects of different concentrations of salts and solvent additives were also studied, demonstrating the potential of the developed hydrogel electrolyte for AZIBs.
Additionally, characterization techniques such as Fourier transform infrared spectroscopy (FTIR), electrochemical impedance spectroscopy (EIS), and voltage polarization of the Zn/Zn symmetric cell with PPP and PAM hydrogel electrolyte were employed to evaluate the properties of the hydrogel electrolyte, indicating improved stability, better conductivity, and structural integrity due to the addition of PEDOT: PSS. The study concludes that the PEDOT: PSS-based hydrogel electrolyte is a promising candidate for use in aqueous battery systems, providing enhanced electrochemical performance and expanding the working potential window.

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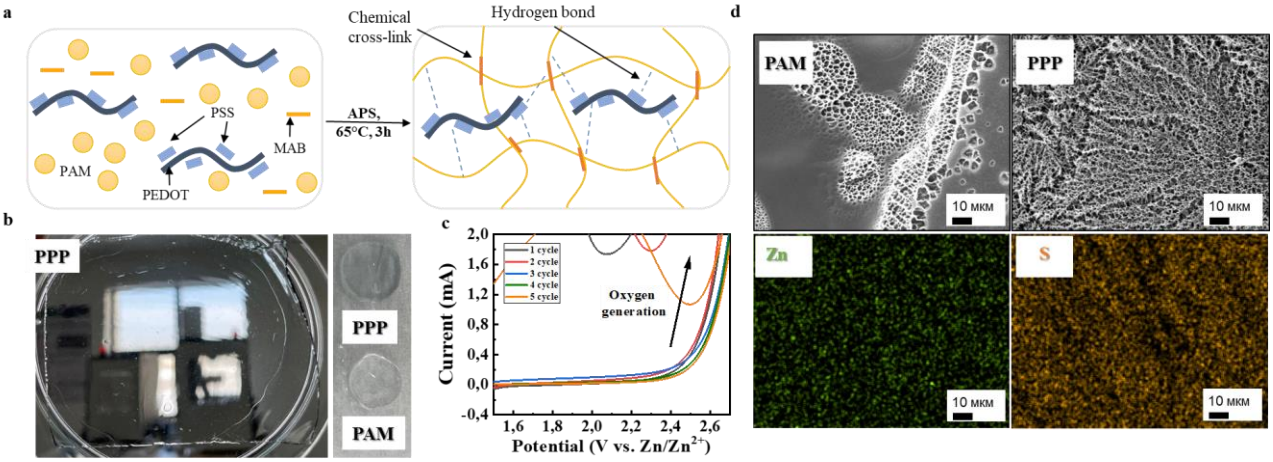

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