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## Three-electrode flexible Zinc-Nickel battery with Black Phosphorus modified polymer electrolyte

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### Abstract:

Secondary flexible zinc-nickel battery was fabricated with the polyvinyl acetate (PVA) gel-polymer electrolyte which containing the black phosphorus (BP). And for the first time, the three electrode system was introduced in the electrochemical analysis for quasi-solid flexible zinc-nickel battery. The BP modified polymer electrolyte has an interpenetrating network structure where PVA works as polymer matrix and BP as  $\text{Zn}(\text{OH})_4^{2-}$  barrier. With the three electrode cell system, tests of Tafel and charge-discharge for the flexible zinc anodes were carried. The results show that the BP in the electrolyte membrane can suppress zinc corrosion and hydrogen evolution reaction. The BP@PVA polymer electrolyte significantly improved the specific discharge capacity and cycle performance of the battery. The flexible zinc-nickel battery with PVA@BP electrolyte shows the high initial discharge capacity of  $509.8 \text{ mA h g}^{-1}$  and retains  $212.8 \text{ mAh g}^{-1}$  after 100 cycles.

### Keywords:

Energy storage and conversion; Interfaces; Nanocrystalline materials; Corrosion; Thin films.

### 1. Introduction

At present, with the development of flexible electrochemical energy conversions and small-scale applications, the demand of flexible battery continues to grow. Considering the flammable of organic electrolyte in li-ion battery, it is unsafe to install it in a device that needs to be folded repeatedly [1].

However, the use of solid electrolytes can significantly improve its safety [2-5]. In contrast, alkaline

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