Fabrication and Testing of Ultra-Long Life Anode Material Using PEDOT-PSS/ Graphene Nanoplatelet Composite for Flexible Li-ion Batteries

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In this work, we report the fabrication of a robust, flexible and free-standing composite film electrode for Li-Ion batteries (LIBs) using a simple bar coating technique. The electrode consists of a conductive composite matrix of poly(3,4-ethylene-dioxythiophene)-poly(styrene sulfonate) (PEDOT-PSS): poly(acrylic acid) (PAA) loaded with Graphene nanoplatelets (GNPs). The successful coating of PEDOT-PSS: PAA on GNPs reduces the surface resistance and protects the electron channels on the GNPs surface from the pulverization effect during charging & discharging cycles. This PEDOT-PSS: PAA: GNPs composite electrode shows excellent cyclability with an initial reversible capacity of 1325 mAhg⁻¹ at a current density of 200 mA g⁻¹. The electrode also displays excellent capacity retention of ~83% with a coulombic efficiency of 99% after 1000 cycles. This composite structure with a porous network induces physical strains in the structure during the Lithium (Li) intake- release process, thereby increasing the interfacial contact area with organic electrolyte. Consequently, the PEDOT-PSS: PAA: GNPs composite electrodes demonstrate improved capability without capacity fading. The composite film shows an improved Young's modulus of 2.4±0.18 GPa to 4.6± 0.18 GPa and Tensile strength of 55±2.5 MPa to 78±2.5 MPa in comparison to pure PEDOT-PSS films. Benefiting from excellent conductivity, superior electrochemical performances, and mechanical flexibility, these hybrid systems could be potential materials towards the fabrication of flexible LIBs in wearable electronics.

Keywords: PEDOT-PSS, Graphene, Li-Ion, Anode, Flexible Batteries,

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