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Organic Molecules Grafted onto Graphene Enable Superior Lithium-Ion Batteries

Abstract
A key challenge faced by organic electrodes is how to promote the redox reactions of functional groups to achieve high-rate capability and long cycling life. One efficient strategy is to stitch organic molecules onto insoluble substrates and inhibit the dissolution. Graphene is a promising alternative with high electronic conductivity, two-dimensional pores and intrinsically insoluble features, which favors promoting the diffusion of ions and conduction of electrons and suppressing the dissolution of organic active materials into aprotic electrolytes. Here we report that the combination of poly(imide-benzoquinone) (PIBN) and tetralithium salts of 2,5-dihydroxyterephthalic acid ($Li_4C_8H_2O_6$) with the graphene substrate exhibits high electrochemical performance in lithium ion batteries for organic electrodes based on the in-situ synthesis and recrystallization method. This enables large reversible specific capacities of 271 (0.1 C) and 193 (10 C) mA h g^{-1} and retention of 86% after 300 cycles for PIBN-graphene (PIBN-G) composite as well as over 1000 cycles at 10 C and high capacities of 191 and 121 mA h g^{-1} after 100 and 500 cycles for the $Li_4C_8H_2O_6$-graphene ($Li_4C_8H_2O_6$-G) composite. Our results indicate a useful strategy for obtaining high-performance organic batteries and a practical way of application of graphene.

References

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Figures

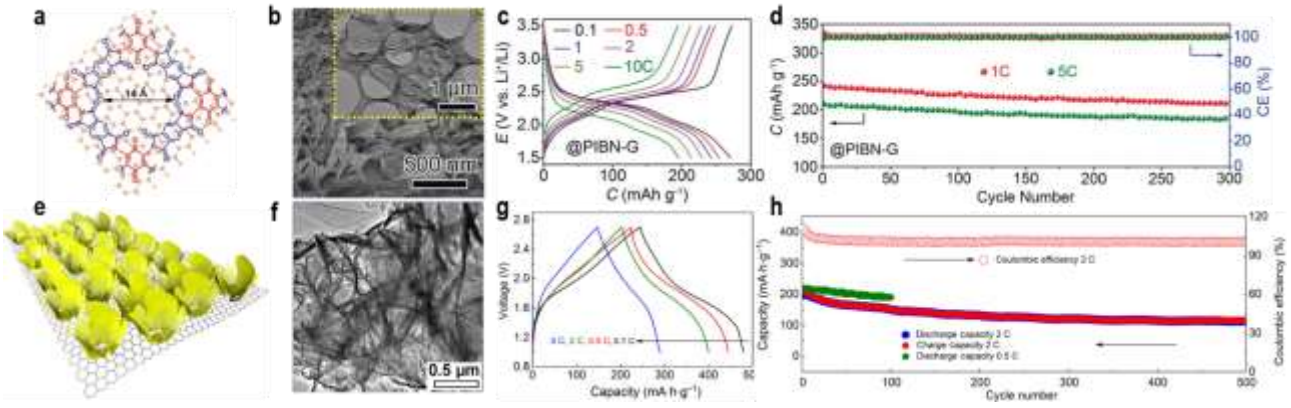

Figure 1: a. Schematic of PIBN-G composite. b. SEM image with an inset of TEM image of PIBN-G. c and d. Discharge/charge profiles and cycle stability of PIBN-G. e. Schematic of $Li_4C_8H_2O_6$-G composite. f. TEM image of $Li_4C_8H_2O_6$-G composite. g and h. Discharge/charge profiles and cycle stability of all-organic symmetrical cells with the $Li_4C_8H_2O_6$-G composite as both the anode and the cathode.