NOVEL SURFACE MODIFICATION OF GRAPHITE WITH EXCELLENT PERFORMANCE FOR LITHIUM ION BATTERY

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Research in exploring alternative high-capacity lithium-ion battery (LIB) anodes in the past decades has predominantly focused on Li-alloying and conversion-reaction anodes. In spite of their potential high capacities, ranging from > 3000 mAh g^{-1} for Si anode to slight higher than 500 mAh g^{-1} for most metal-oxide conversion anodes, lithiation of these anodes involves formation of low-density lithiated products, resulting in tremendous volume expansion. The cyclic dimensional variations during charging-discharging cycles is known to result in pulverization of active-material particles and cracking and crumbling of electrode structure, leading to fast capacity fading and poor cycle life. On the contrary, graphite has an excellent cycle stability based on its theoretical lithiation capacity of 372 mAh g-1 with the potential plateau taking place well below 0.2 V (versus Li/Li). Composite anodes, therefore, comprising a limited amount of the alloying anodes, such as Si, to enhance the capacities of the graphite (G) anodes have been considered as attractive transient products for advanced high-energy LIBs before fully alloying anodes can be realized. In this paper, we report for the first time the use of thiophene-based conducting polymer blend, namely PEDOT-PSS, as a "capacity-amplifier" of several graphite-based anodes. PEDOT-PSS can be easily coated on the graphite surface by a conventional mixing-and-drying process and the electrode exhibits enhancing capacity (>700 mAh g^{-1}) and good cycle stability (>600 mAh g^{-1} after 300 cycles at 50 ^{o}C) without suffering from the volume expansion-induced capacity fading problem.

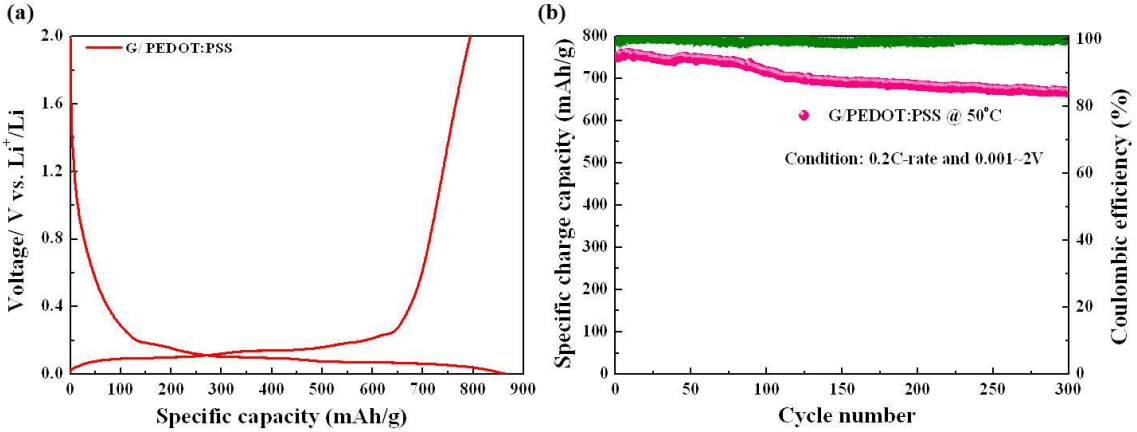

Figure 1(a) the second cycle charge–discharge voltage plots of G/ PEDOTPSS electrode acquired at 0.1 C-rate; (b) specific capacity versus cycle number of G/ PEDOTPSS electrode at a current density of 0.2 C-rate at 50 ^{O}C.