Highly Reliable Quinone-Based Cathode and Cellulose Nanofiber Separators: Toward Eco-Friendly Organic Lithium Batteries

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To overcome the disadvantages of the conventional inorganic cathode materials such as low capacities (<170 mAh g-1) and disposal problem, the organic compounds have recently been considered as promising candidates for the next generation of energy storage systems. Especially, Pillar[5]quinone (P5Q) can not only implement a high theoretical capacity of 446 mAh g−1 but also realize so effective for the use of the active sites that it is able to favorable to Li uptake. We fabricated the cathode using the P5Q enveloped in Multi-walled Carbon Nanotube (MWCNT) with simple vacuum filtering, solving the issues of high solubility in aprotic electrolytes and low conductivity as organic compounds. The vacuum filtration method was able to increase the loading level of cathode and obtain binders/current collector-free films. Furthermore, Cellulose Nanofibers (CNFs) were introduced as an alternative to the convectional polyolefin separator. The CNF separator showed less capacity fading as well as the improvements in the ionic conductivity, electrolyte wettability, and thermal shrinkage. Suggested battery exhibited high specific capacity of 400~420 mAh g-1 and improved cycle performance.