Surface Modification of Coal-Based Coke Powder with Pitch Powder for Lithium Ion Batteries

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As we all know, most of coal-based coke powders are burned as cheap fuel or discarded directly every year, causing serious environmental contamination and enormous waste of resources. Fortunately, previous works have proved that coal-based coke powder is a promising anode material for lithium ion batteries, while the low initial coulombic efficiency and large irreversible capacity of coal-based coke powder limit its large-scale application. In this work, three kinds of surface-modified coal-based coke powders with pitch powder as the anode materials for lithium ion batteries were developed. Results showed that, compared to the samples C_T (prepared with pitch powder pre-coating in toluene solution) and C_A (prepared with pitch powder pre-coating in alcohol solution), the surface modification of coal-based coke powder prepared by mixing the mixture of coke powder and pitch powder (C_M) was found to be the most effective in improving the initial reversible capacity and initial coulombic efficiency of coal-based coke powder. After coating with the pitch-based carbon layer, the initial irreversible capacity of coke powder reduced from 87.5 mAh/g to 65.3 mAh/g, and the initial coulombic efficiency significant improved from 78.5% to 84.3%. Scanning electron microscopy (SEM) and X-ray diffraction (XRD) were then employed to investigate the samples, the effects of surface modification on the formation of the solid electrolyte interphase (SEI) and the corresponding irreversible capacity losses were discussed. Finally, the influence of the mass contents of pitch powder on the morphology and electrochemical performance of the sample C_M were analyzed.

Keywords: lithium ion batteries; pitch powder; coal-based coke powder; surface modification; electrochemical properties.

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