SOL-GEL SYNTHESIS AND ELECTROCHEMICAL EVALUATION OF $LiCO_2$ CATHODE FOR LITHIUM-ION BATTERIES

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Lithium Cobalt Oxide ($LiCoO_2$ or LCO) was the first cathode to achieve commercial success in lithium-ion batteries (LIBs) and continues to dominate over 90% of the market for cathode materials used in LIBs for portable electronic devices[1]. However, its primary synthesis method, the solid-state reaction, has significant drawbacks, such as impurities from secondary reactions, minimal control over particle size, and reduced elemental uniformity[2]. In this context, the sol-gel method has become an alternative for synthesizing LCO due to its excellent stoichiometric control, absence of parasitic reactions, and ease of operation[3]. Therefore, this study aims to synthesize $LiCoO_2$ cathode using the sol-gel method and evaluate its galvanostatic cycling behavior. Stoichiometric quantities of $LiNO_3$ and $C_4H_6CoO_4{\cdot}6H_2O$ were used to prepare a 1.35 mol/L metal solution. This solution was dripped into a 1.35 mol/L citric acid solution, which was then adjusted to pH 7. The mixture was stirred and heated to 90 °C until a viscous gel was formed. The gel was dried in an oven at 200 °C for 12 hours and pre-calcined at 450 °C for 6 hours. Finally, the obtained precursor was calcined at 850 °C for 12 hours to produce the LCO. The material's morphology and structure were assessed using scanning electron microscopy (JEOL, JSM 6010LA) and X-ray diffraction (XRD) (Bruker, D8 Advance) respectively. Cathode electrodes were prepared using 80% LCO, 10% carbon black, and 10% PVDF deposited on aluminum foil. Coin cells (CR2032) were assembled in a glove box using LCO as the cathode, metallic Li as the anode, and $LiPF_6$ dissolved in ethylene carbonate/diethyl carbonate (Sigma Aldrich) was used as an electrolyte. The electrochemical performance was evaluated through galvanostatic charge and discharge curves operating with a current density of 0.1C over a potential range of 2.8 – 4.3V for 10 cycles (BioLogic VMP3 cycler). According to XRD patterns, the peaks were indexed to a layered structure with good hexagonal ordering and no impurities. The results presented in Figure 1 show that the material achieved a specific capacity of 156 mAh/g, which was higher than the 140 mAh/g reported in the literature for LCO materials synthesized by solid-state reaction[3]. Additionally, after 10 cycles, the material retained 91% of its initial discharge capacity. Thus, the results suggest that the sol-gel method can produce LCO with excellent electrochemical properties.

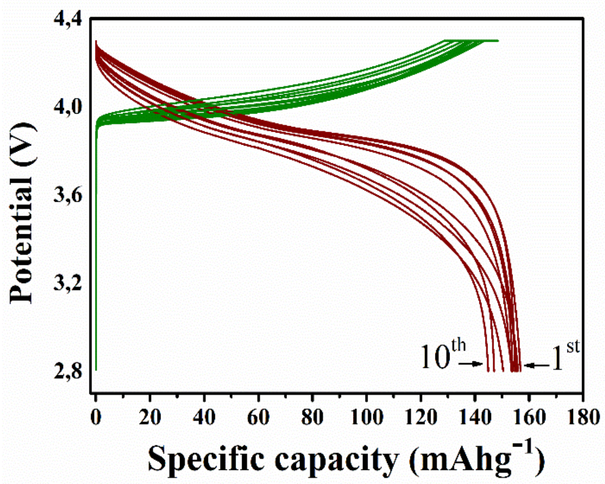

Figure 1. Charge and discharge curves using the LiCoO2 cathode synthesized by the sol-gel method.

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