Electrochemical Performance of $\text{LiNi}_{0.3}\text{Co}_{0.3}\text{Mn}_{0.3}\text{O}_2$ - $\text{Li}_{1.3}\text{Al}_{0.3}\text{Ti}_{1.7}(\text{PO}_4)_3$ Composites Prepared by Dielectric Barrier Discharge Plasma Assisted Milling

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The development of electric vehicles and portable electronic devices demand lighter and thinner batteries with improved specific charge and rate capabilities. In this work, we prepared $\text{LiNi}_{0.3}\text{Co}_{0.3}\text{Mn}_{0.3}\text{O}_2$ (NCM) using a co-precipitation route. $\text{Li}_{1.3}\text{Al}_{0.3}\text{Ti}_{1.7}(\text{PO}_4)_3$ (LATP) was synthesized using a solid state reaction method. $\text{LiNi}_{0.3}\text{Co}_{0.3}\text{Mn}_{0.3}\text{O}_2$ - $\text{Li}_{1.3}\text{Al}_{0.3}\text{Ti}_{1.7}(\text{PO}_4)_3$ (NCM-LATP) composites, with spherical agglomerates of NCM particles being homogeneously dispersed in micro-sized LATP matrix, had been prepared by dielectric barrier discharge plasma assisted milling (DBDP-milling) for the first time. We analyzed surface morphologies and structures of the LATP, NCM and NCM-LATP samples by using scanning electron microscopy (SEM) and X-ray diffraction (XRD). We analyze performances of model NCM-LATP materials. The results show that the NCM-LATP composites exhibits excellent cycles stability to reach 127.4, 118.7 and 109.5 mAh g⁻¹ at 0.2, 0.5 and 1C (at room temperature), respectively. The NCM-LATP composites cathode and NCM cathode had a discharge capacity of 155.9 and 136.2 mAh g⁻¹ at the first cycle, and the corresponding coulombic efficiencies are 92.96% and 74.75%, at 0.05 C. Charge-discharge curves, Cyclic voltammetry and AC impedance response indicated that both NCM and LATP phases in the composite cathode were involved during the oxidation-reduction reactions and the electron transport resistance in the pure NCM cathode was much higher than that in the NCM-LATP composites cathode.

Keywords: $\text{LiNi}_{0.3}\text{Co}_{0.3}\text{Mn}_{0.3}\text{O}_2$ - $\text{Li}_{1.3}\text{Al}_{0.3}\text{Ti}_{1.7}(\text{PO}_4)_3$ composites; discharge plasma; ball milling; cathode; lithium-ion batteries

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