Electronic supplementary information (ESI)

Controlled synthesis of $\text{Co}_x\text{Mn}_{3-x}\text{O}_4$ nanoparticles with tunable composition and size for high performance lithium-ion batteries

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Fig. S1 IR spectrum of H$_3$BTC (the starting material) and Co$_x$Mn$_{3-x}$-BTCs. It is observed that in the FTIR spectrum of Co$_x$Mn$_{3-x}$-BTCs, the characteristic bands ($\nu_{OH}$, 3084 cm$^{-1}$; $\nu_{C=O}$, 1721 cm$^{-1}$; $\delta_{C=O}$, 540 cm$^{-1}$) of the nonionized carboxyl groups of 1,3,5-BTC disappear, and new bands appear in the regions 1616–1559 cm$^{-1}$ (asymmetric stretching vibrations of $-\text{COO}^-$), 1441–1378 cm$^{-1}$ (symmetric stretching vibrations of $-\text{COO}^-$), and at 769 cm$^{-1}$ (ring-out-of-plane vibration of the 1,3,5-substituted benzene core of the linker molecules), which suggests that the metal ions have been coordinated with the 1,3,5-BTC ligands successfully. A similar kind of observation has been made for manganese 1,3,5-benzenetricarboxylate MOF.  

Fig. S2 EDX spectra of Co$_x$Mn$_{3-x}$-BTC compound with x=2.00 on selected area. The sample was composed of Co, Mn, O and C.
Fig. S3 (a) SEM Image and (b-e) EDX mapping images of the Co$_x$Mn$_{3-x}$-BTC compound with $x=2.00$ on selected area. The homogeneous distribution of Co and Mn elements in the whole sample indicated that the reaction of 1,3,5-benzenetricarboxylic acid ligand with Co and Mn ions could result in bimetallic CPs as pure phase rather than a mixture of two homometallic CPs.

Fig. S4 TG analysis curves of the as-synthesized Co$_x$Mn$_{3-x}$-BTCs under air flow.
Fig. S5 SEM images of MnCo$_2$O$_4$ particles for different calcinating temperatures: (a) 400 °C (MnCo$_2$O$_4$-400C), (b) 600 °C (MnCo$_2$O$_4$-600C), and (c) 800 °C (MnCo$_2$O$_4$-800C).
Fig. S6 EDX spectra and corresponding element analysis of (a) MnCo$_2$O$_4$-400C, (b) MnCo$_2$O$_4$-600C, and (c) MnCo$_2$O$_4$-800C.
Fig. S7 EDX mapping images for a selected region of (a) MnCo$_2$O$_4$-400C, (b) MnCo$_2$O$_4$-600C, and (c) MnCo$_2$O$_4$-800C.
Fig. S8 Nitrogen adsorption/desorption isotherms of (a) MnCo$_2$O$_4$-400C, (b) MnCo$_2$O$_4$-600C, and (c) MnCo$_2$O$_4$-800C.
Fig. S9 TGA curve of MnCo$_2$O$_4$-400C under air flow.

References
