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SUPPORTING INFORMATION

Temperature-Engineered $MnO/Mn_3O_4/C$ Composites Derived from DMAc for High-Performance Lithium-Ion Batteries

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Table S1. Typical performance of MnO, Mn_3O_4, Mn_3O_4/C, and mixed MnO/Mn_3O_4/C systems.

Material System	Reversible Capacity	Cycling Stability	Discription	Ref.
Mn_3O_4 (pure)	600–900 mAh g^{-1} (initial)	Often retains only 15–30% after 50–100 cycles	Low conductivity, severe volume change, unstable SEI, rapid fading	[13], [16]
MnO (pure)	650–900 mAh g^{-1}	Moderate fading; suffers pulverization	High theoretical capacity but limited stability due to large volume expansion	[17]
Mn_3O_4/C composite	700–1000 mAh g^{-1}	Capacity retention 70–90% over 100+ cycles	Carbon boosts electrical pathways, buffers strain, stabilizes SEI	[13], [30]
Mixed MnO/Mn_3O_4	850–1100+ mAh g^{-1}	Improved stability vs. single phases	Multiple redox couples, oxygen vacancies, defect-assisted kinetics	[41]
Mixed MnO/Mn_3O_4/C (this work)	861 mAh g^{-1} at 0.2 A g^{-1}	473 mAh g^{-1} after 1000 cycles at 0.5 A g^{-1}	Synergistic Mn^{2+}/Mn^{3+} redox couples, conductive in-situ carbon network, optimized oxygen vacancy distribution	This work

Table S1 summarizes the typical electrochemical performance of MnO, Mn_3O_4, Mn_3O_4/C, and mixed MnO/Mn_3O_4/C anodes reported in the literature. Pure Mn_3O_4 and MnO generally exhibit limited cycling stability due to poor conductivity and severe volume expansion, whereas carbon-hybrid and mixed-valence systems demonstrate significantly enhanced durability and rate capability. The Mn–N5 electrode in this study achieves performance comparable to or surpassing many state-of-the-art Mn_xO_y/C systems, validating the effectiveness of DMAc-derived mixed-valence and carbon-network engineering.

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