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Supplementary Information

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Achieving electrochemical capacitor functionality from a traditional battery material: conformal, nanoscale $LiMn_2O_4$ coatings on 3-D, device-ready carbon nanoarchitectures

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XAS experimental details

The K-edge absorption was isolated by fitting the pre-edge region (6239–6439 eV) with a quadratic polynomial, extrapolating over the entire range of the spectrum, and subtracting the pre-edge background from the entire spectrum. Step normalization was applied using the atomic absorption, which was determined by fitting the post edge region (6639–8040 eV) with a cubic polynomial. The photoelectron wave number was derived by setting the inner potential to the inflection point energy. The extended X-ray absorption fine structure (EXAFS) data, $\chi(k)$, were extracted using multi-node cubic spline procedures applied to k^3-weighted spectra over the k-range of 2.0–15.0 $Å^{-1}$. The post-edge background was optimized by minimizing the amplitude of non-physical peaks in the 0–0.9 Å region of the Fourier transform. The data analysis up to this point was carried out using the WinXAS software package (version 3.1).[1,2] The Fourier transforms presented here were generated with k^3-weighted EXAFS spectra over the range 3.0–15 $Å^{-1}$ and a Hanning window of 1.0 $Å^{-1}$ using the curve fitting code FEFFIT (version 2.984) of the University of Washington XAFS (UWXAFS) software package.[3]

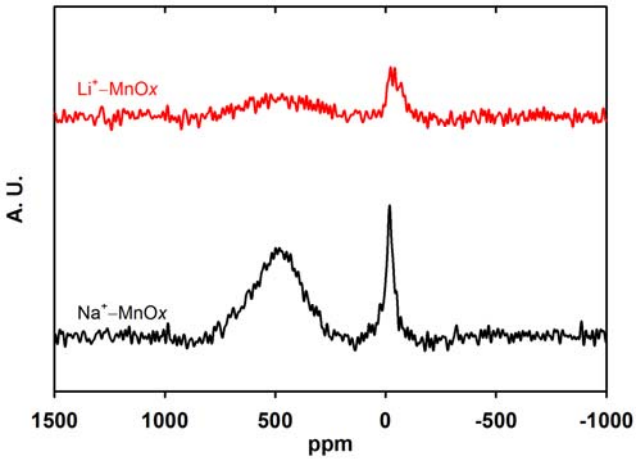

Fig. S1. Solid-state ^{23}Na nuclear magnetic resonance spectra of Na^+-MnO*x* (—) and Li^+-MnO*x* (—).

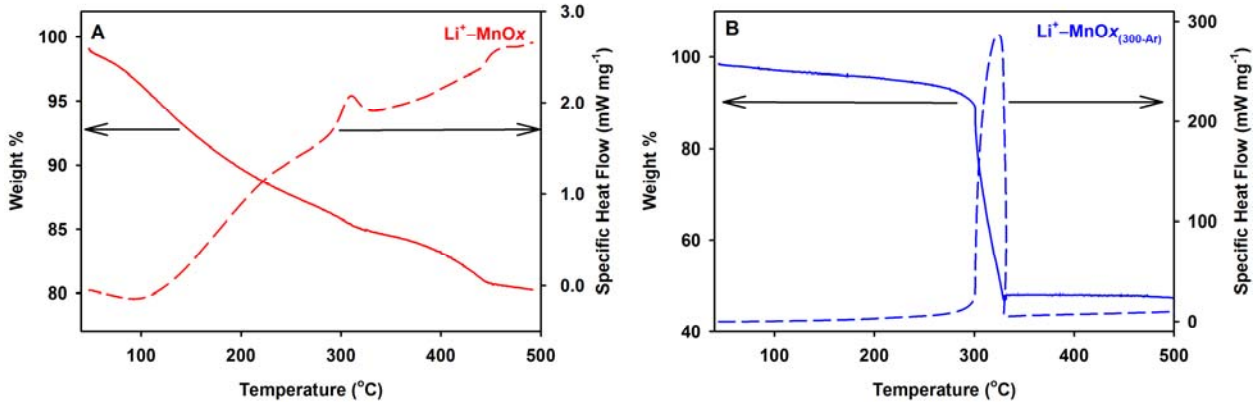

Fig. S2. Thermal gravimetric analysis (—) and differential scanning calorimetry (– –) of (A) Li^+-MnO*x* in an argon atmosphere and (B) Li^+-MnO$x_{(300\text{-}Ar)}$ in an oxygen atmosphere.

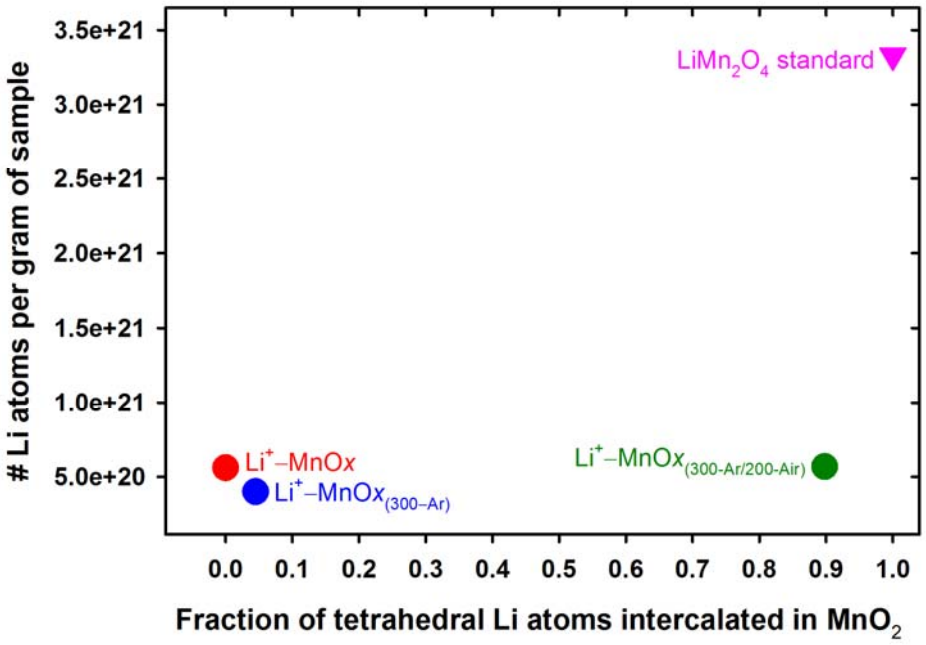

Fig. S3. Plot of # of Li atoms per gram of sample versus fraction of Li atoms in tetrahedral site derived from solid-state ^{7}Li NMR for $LiMn_2O_4$ standard (▼), Li^+-MnO*x* (●), Li^+-MnO$x_{(300\text{-}Ar)}$ (●), and Li^+-MnO$x_{(300\text{-}Ar/200\text{-}Air)}$(●).

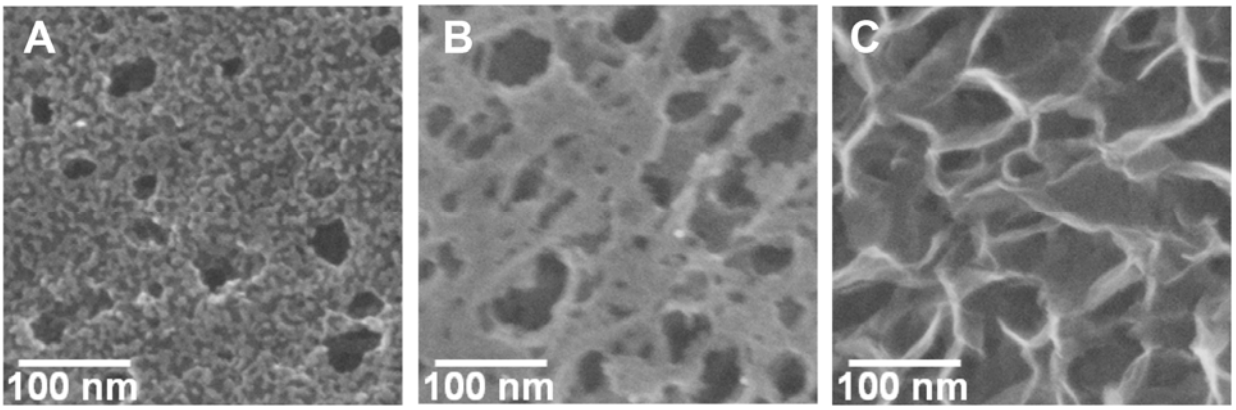

Fig. S4. Scanning electron micrographs of the exterior surface of (A) Li^+-$MnOx_{(300\text{-}Ar/200\text{-}Air)}$, (B) Li^+-$MnOx_{(300\text{-}Ar/200\text{-}Air)}$ after 200 voltammetric cycles in 2.5 M Li_2SO_4, and (C) Li^+-$MnOx_{(300\text{-}Ar/200\text{-}Air)}$ after 200 cycles in 2.5 M Li_2SO_4 + 20 mM $NaHCO_3$.

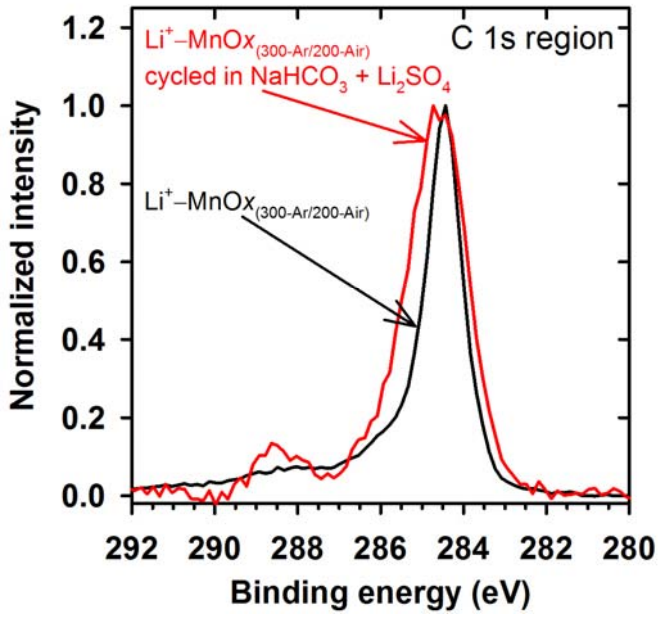

Fig. S5. X-ray photoelectron C1s spectra of Li^+-$MnOx_{(300\text{-}Ar/200\text{-}Air)}$ (—) and Li^+-$MnOx_{(300\text{-}Ar/200\text{-}Air)}$ after 200 voltammetric cycles in 2.5 M Li_2SO_4 + 20 mM $NaHCO_3$ (—).

Notes and references

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