Supporting Information:

Nitrogen/Carbon Atomic Ratio-Dependent Performances of Nitrogen-Doped Carbon-Coated Metal Oxide Nanocrystals for Anodes in Lithium-Ion Batteries

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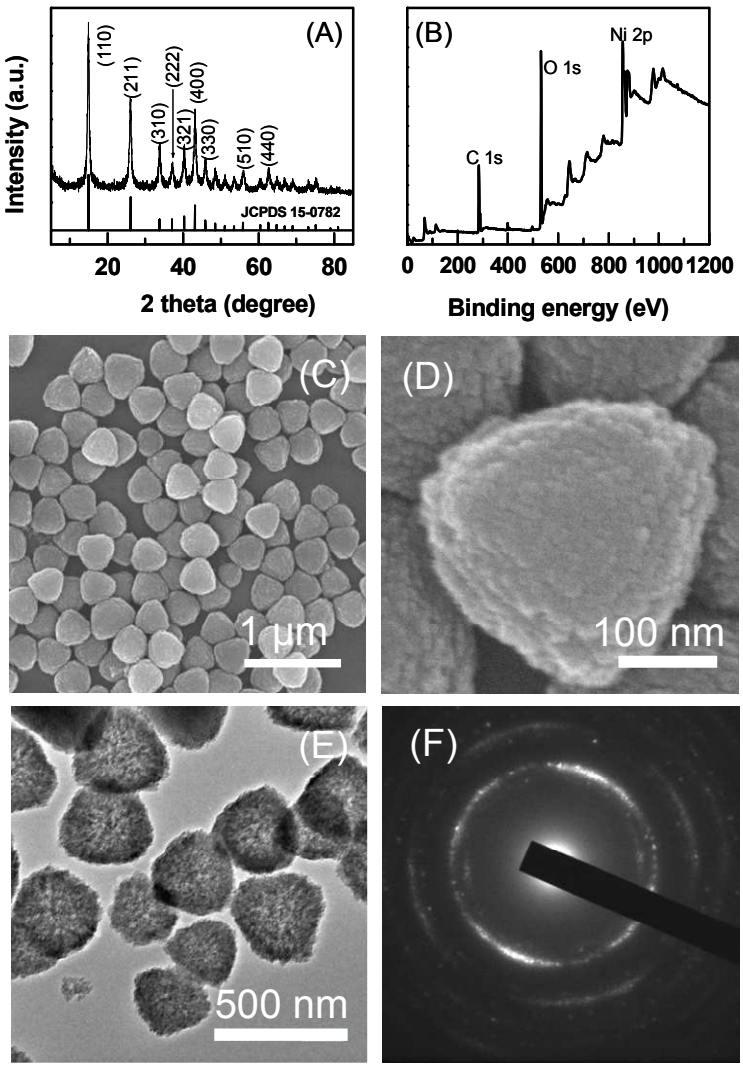

Figure S1. XRD patterns (A), XPS (B), SEM (C, D), and TEM images (E) of the as-prepared $Ni(HCO_3)_2$ precursors. (F) Typical SAED patterns of the prepared $Ni(HCO_3)_2$ precursors.

XRD patterns confirm the formation of $Ni(HCO_3)_2$ precursor because all the peaks observed can be indexed to characteristic peaks ((110), (211), (310), (222), (321), (400), (330), (510), and (440)) of $Ni(HCO_3)_2$ with body-centered cubic structure (JCPDS No. 15-0782) (Figure S1A). No peaks corresponding to other substances such as $Ni(OH)_2$ or $Ni_2(OH)_2CO_3$ are observed. XPS indicates the presence of Ni (855.9 eV), C (284.6 eV), and O (531.6 eV) elements in the precursor with the Ni, C, O atomic ratio of ~1:2.2:6.3 (evaluated by integrating the area under the correspondent peaks) (Figure S1B), which is in accordance with the theoretical one. These results demonstrate that we have prepared the $Ni(HCO_3)_2$ precursor. SEM (Figure S1C, D) and TEM images (Figure S1E) show the precursor has a

triangle-like shape with the size of ~280–320 nm and are composed by numerous small particles with the size of about 10–20 nm (Figure S1D). The selected area electron diffraction (SAED) pattern (Figure S1F) of the synthesized precursor shows concentric rings composed of bright discrete diffraction spots, indicating that the prepared $Ni(HCO_3)_2$ is polycrystalline with a high degree of crystallinity.

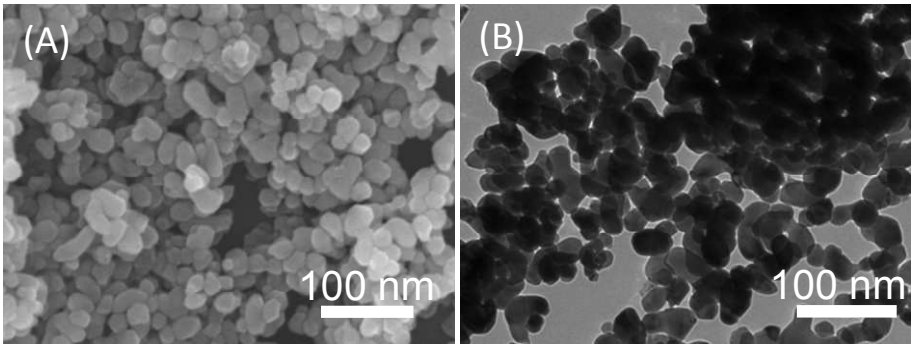

Figure S2. The SEM (A) and TEM images (B) of the prepared pristine NiO NPs.

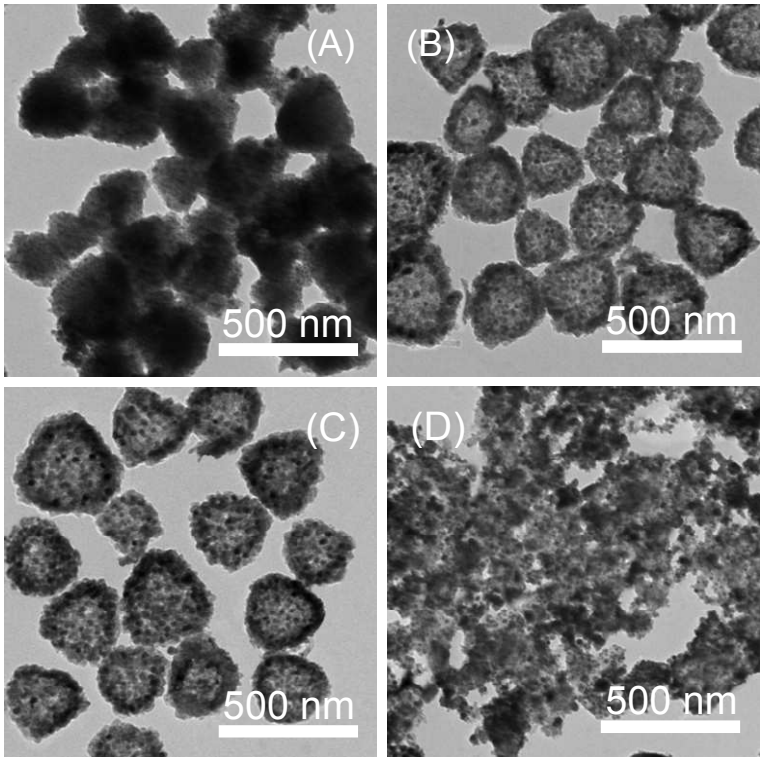

Figure S3. Dependence of the morphologies of the EM-N-C-NiO NCs on the time of the heat treatment of the $Ni(HCO_3)_2$ precursors in $EMImBF_4$. The heat treatment time is: (A) 2, (B) 3, (C) 4, and (D) 5 h.

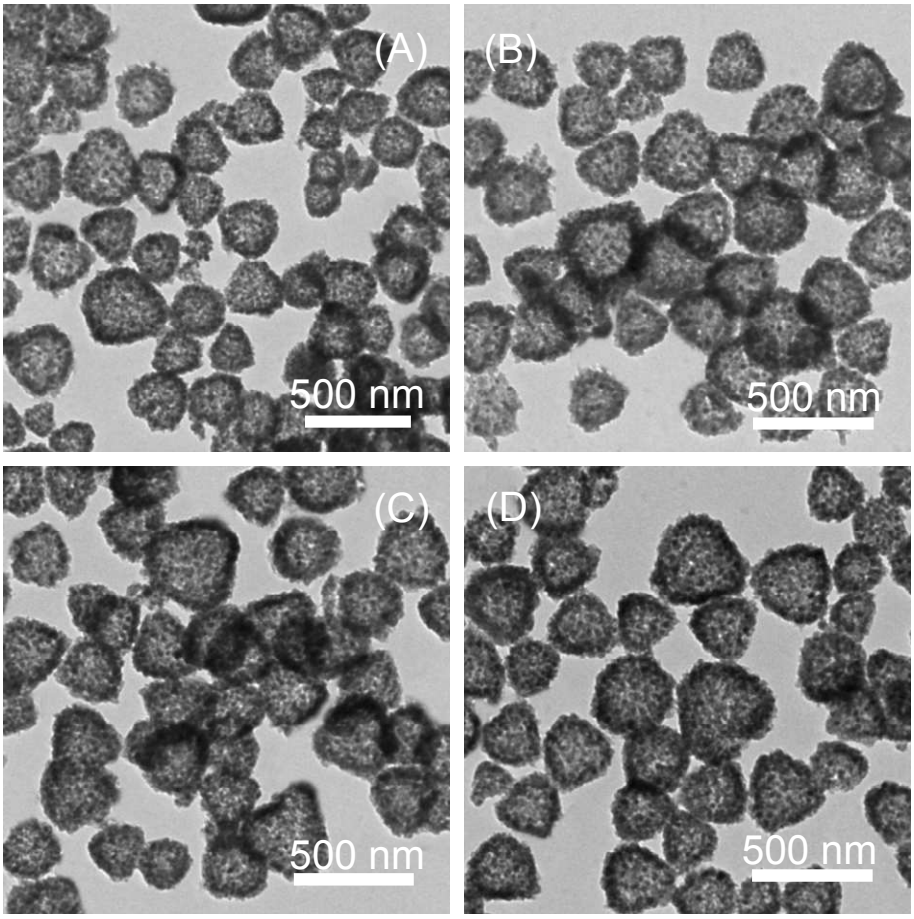

Figure S4. Dependence of the morphologies of the prepared EM-N-C-NiO NCs on the heat treatment temperature of the $Ni(HCO_3)_2$ precursors in $EMImBF_4$. The heat treatment temperature is: (A) 120, (B) 150, (C) 180, and (D) 210 °C. The heat treatment time is 4 h.

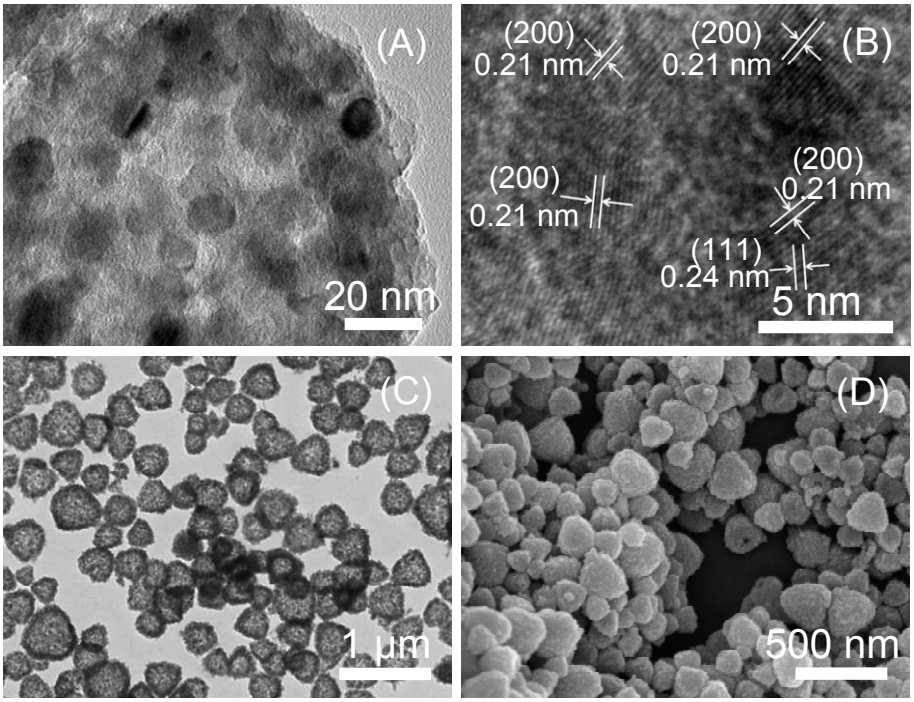

Figure S5. TEM (A, C), HRTEM (B), and SEM images (D) of the prepared BM-N-C-NiO NCs. The N-C-NiO NCs are assembled to form hollow structured cluster networks with sizes of ~250–300 nm. The BM-N-C-NiO NCs were obtained by calcining the $BMImBF_4$-coated $Ni(HCO_3)_2$ for 3 h at 350 °C under Ar atmosphere. The $BMImBF_4$-coated $Ni(HCO_3)_2$ were prepared by heat treatment of the $Ni(HCO_3)_2$ precursors in $EMImBF_4$ for 3–4 h at 180 °C.

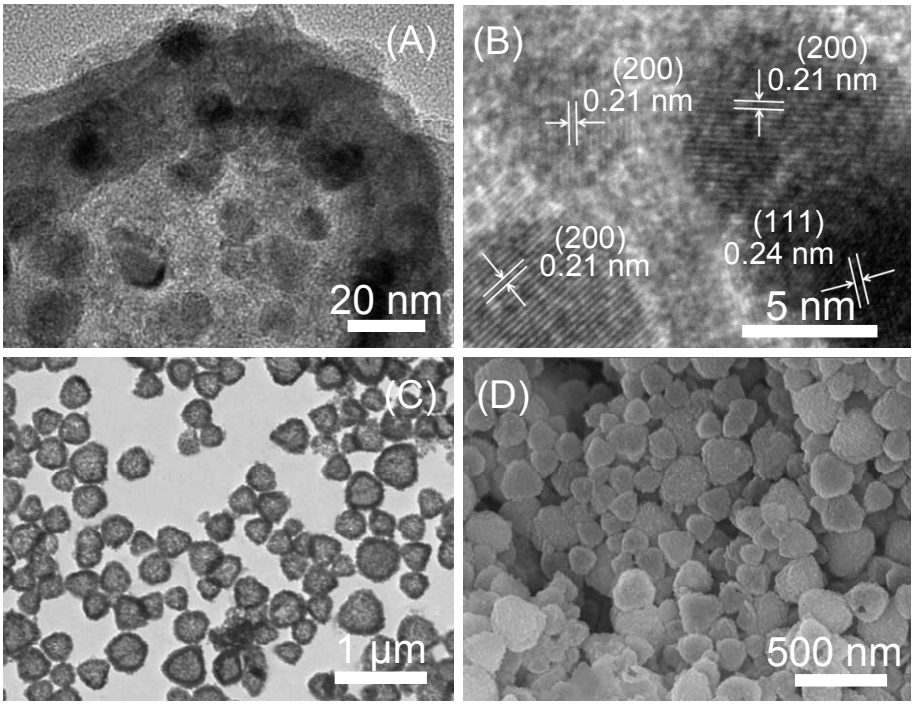

Figure S6. TEM (A, C), HRTEM (B), and SEM images (D) of the prepared HM-N-C-NiO NCs. The N-C-NiO NCs are assembled to form hollow structured cluster networks with sizes of ~250–300 nm. The HM-N-C-NiO NCs were obtained by calcining the $HMImBF_4$-coated $Ni(HCO_3)_2$ for 3 h at 350 °C under Ar atmosphere. The $HMImBF_4$-coated $Ni(HCO_3)_2$ were prepared by heat treatment of the $Ni(HCO_3)_2$ precursors in $EMImBF_4$ for 3–4 h at 180 °C.

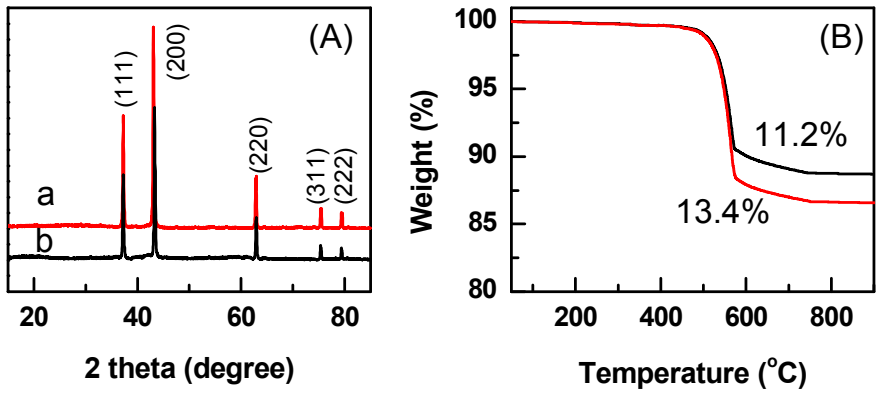

Figure S7. XRD patterns (A) and TGA measurements (B) of the BM-N-C-NiO NCs (curve a) and HM-N-C-NiO NCs (curve b).

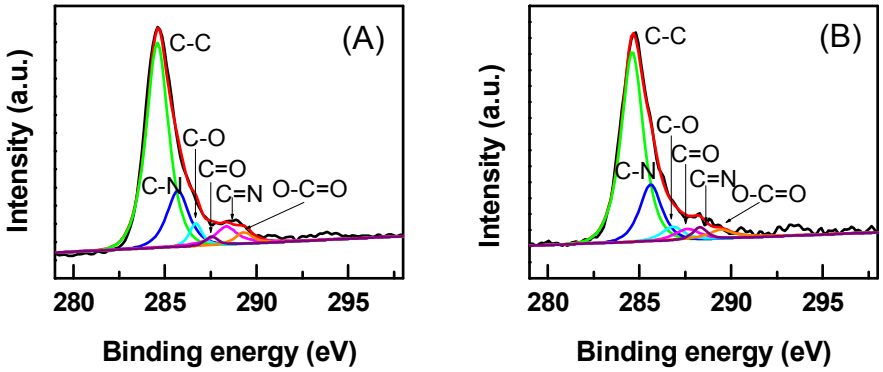

Figure S8. High resolution XPS spectra of C1s and their related curve-fitted components for the BM-N-C-NiO NCs (A) and HM-N-C-NiO NCs (B).

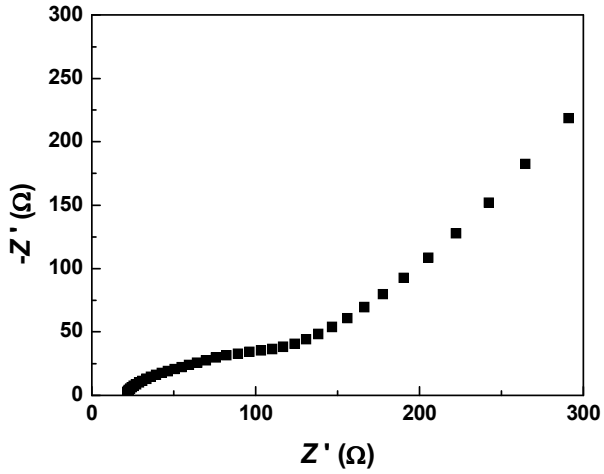

Figure S9. Electrochemical impedance spectra of the fresh pristine NiO NPs electrode in a coin half cell over the frequency range from 100 kHz to 0.01 Hz.