Electronic Supplementary Information

A bio-facilitated synthetic route for nano-structured complex electrode materials

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1. Raman spectroscopy

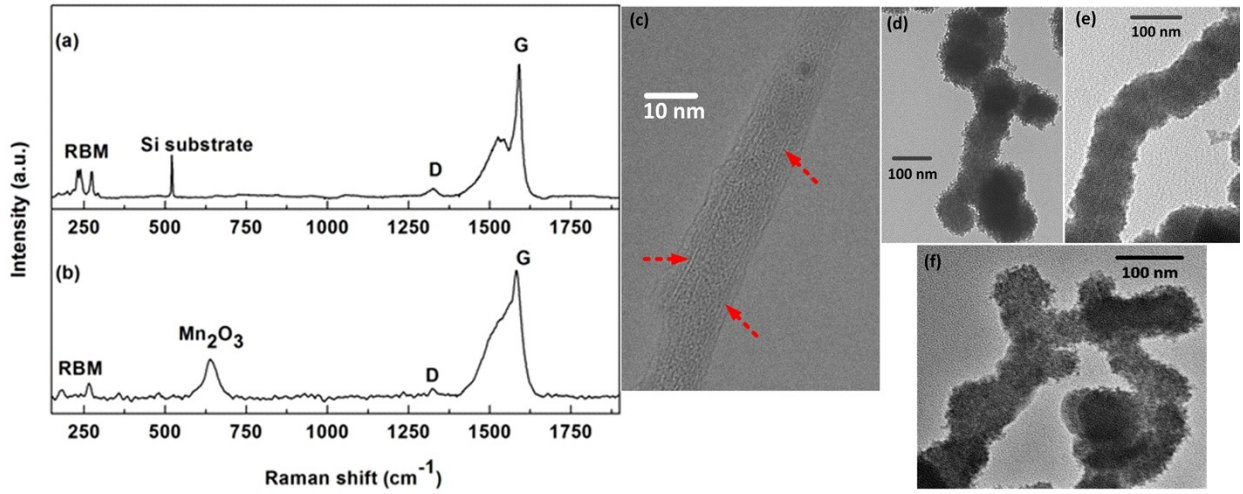

Figure S1: Raman spectra obtained from M13 virus-SWCNT complex on Si substrates (a) before and (b) after the mineralization. The spectra show the radial breathing modes (RBM), D-band, G-band confirming the presence of SWCNT in the material. TEM image of (c) M13-SWCNT complex (red arrow showing SWCNT on the virus), and the grown MnO_x on (d)&(e) M13 virus and (f) M13-SWCNT complex comparing the morphology of the material with and without SWCNT.

To check SWCNT in the material, Raman spectroscopy is performed with Horiba Jobin-Yvon HR 800. Figs. S1a and b show the Raman spectra of M13 virus-SWCNT after the complexation before and after bio-mineralization, respectively. In both cases, the radial breathing mode (RBM) peaks as well as the G and D peaks from SWCNT are observed. The Raman spectra of the bio-mineralized seed material agrees with that of a manganese (III) oxide (Mn_2O_3). HRTEM image of M13-SWCNT in Fig. S1 a and b show that SWCNT does not alter the structure and morphology of LiMnBO3 particles. This is explained by the fact that the SWCNT are mainly covered by the grown active materials.

2. Electrochemical test:

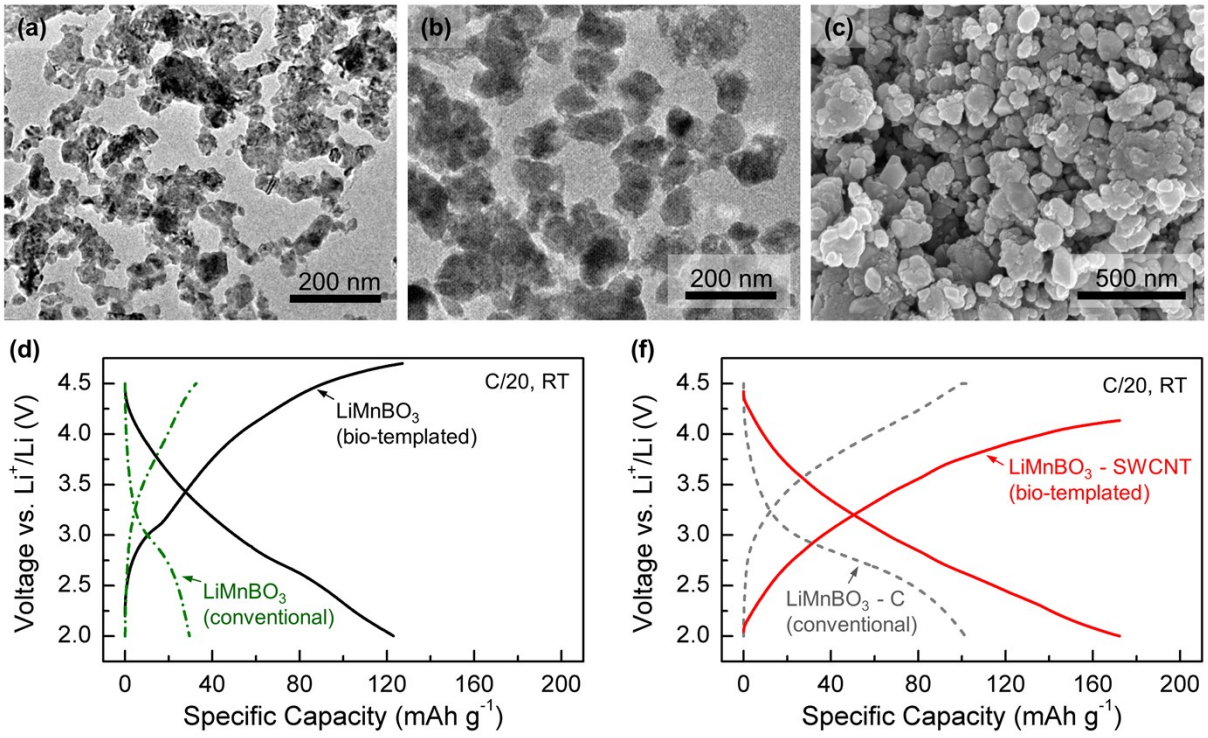

Figure S2: TEM images obtained from (a) bio-templated, also shown in Fig. 1g, and (b) conventionally synthesized $LiMnBO_3$, (c) an SEM image of conventionally synthesized $LiMnBO_3$, and voltage *vs*. specific capacity profiles of bio-templated and conventionally synthesized $LiMnBO_3$ (d) without and (e) with conductive phase attachment at C/20.

TEM images of both compounds in Fig. S2a and b and the SEM image of conventionally prepared $LiMnBO_3$ in Fig. S2c show clear difference between two materials. The size of the conventional $LiMnBO_3$ particle ranges from 50 to 300 nm. Voltage profiles of $LiMnBO_3$ synthesized by bio-templated technique and (conventional) solid-state method are plotted as a function of specific capacity at a C/20 rate in Fig. S2. The discharge capacity of the bio-templated $LiMnBO_3$ cathode is 125 mAh g^{-1}, as shown in Fig. S2a, which is almost four times larger than that of conventional $LiMnBO_3$ without carbon coating. This result clearly shows how nanosizing affects the battery performance in $LiMnBO_3$. In Fig. S2b, SWCNT incorporated bio-templated $LiMnBO_3$ outperforms carbon coated conventional $LiMnBO_3$.