On the Electrochemical Properties of Carbon Coated $NaCrO_2$ for Na-ion Batteries

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Supplementary Materials

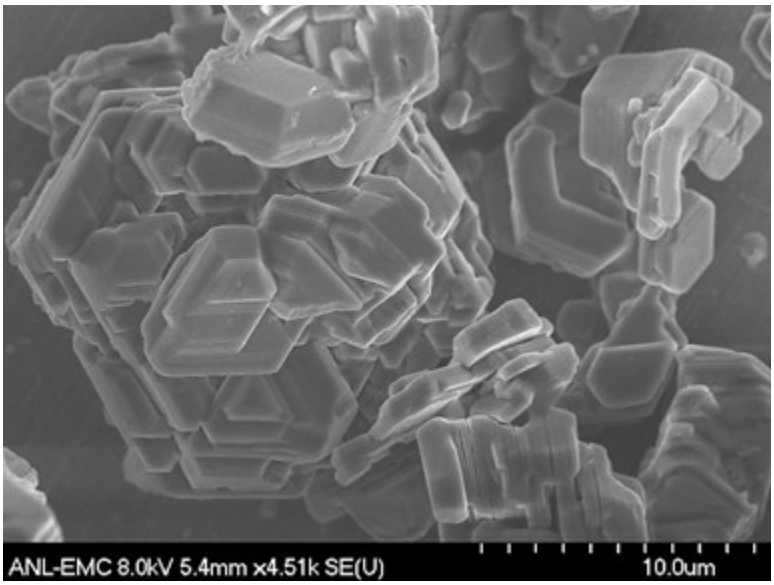

Figure S1. FESEM image of $NaCrO_2$ particles formed via ball milling at ambient temperature for 1 h followed by high-temperature reaction at 900°C for 1 h [11].

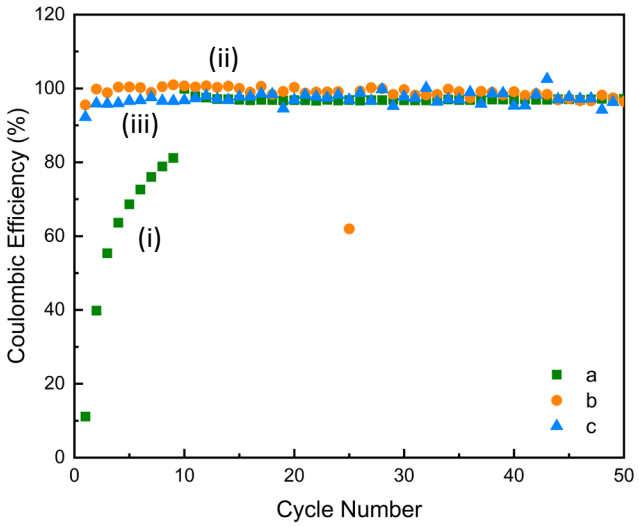

Figure S2. Coulombic efficiencies of B3 half cells as a function of CB loading in the cathode: (i) 10 wt.%, (ii) 20 wt.%, and (iii) 30 wt.%.

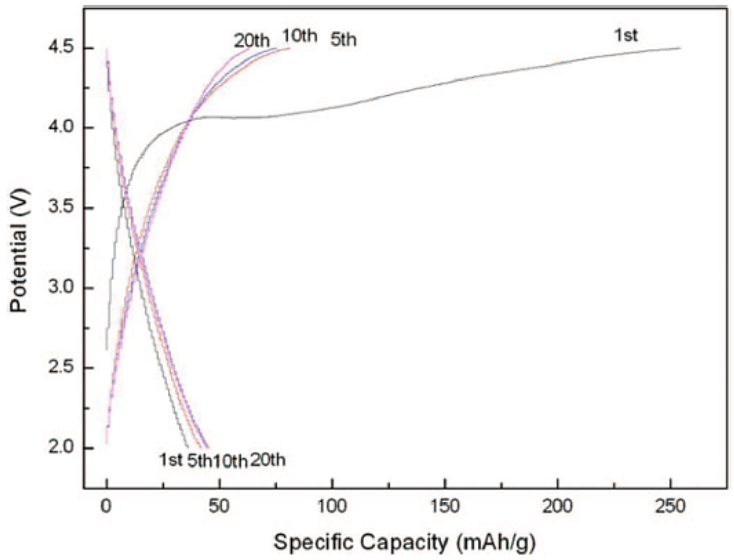

Figure S3. The charge/discharge curves of a half cell with the cathode made of 100% CB and a Na chip as the reference and counter electrode. The electrolyte used was the same as $NaCrO_2$ half cells, i.e., 1.0 M $NaPF_6$ in propylene carbonate (PC) with 2 vol. % of fluoroethylene carbonate (FEC).

Discussion of Figure S3: The specific capacity is 35.8 mAh/g-CB at the first discharge. We attribute this charge storage to surface absorption of Na ions via the electrical double layer (EDL) mechanism. The evidence of supporting this argument is that dQ/dV of the discharge curve is nearly constant. The specific capacity increases slightly from the first discharge to the 10^{th} discharge, most likely due to the improved wetting of the CB particles by the electrolyte. However, beyond the 10^{th} discharge the specific capacity exhibits no changes at all, again displaying the electrochemical capacitor behavior since it is well known that electrochemical capacitors can charge/discharge for several-thousand times with little or no capacity fading. The slightly non-linear curve for the charge curve at the high voltage portion is likely due to the formation of the solid electrolyte interphase (SEI) layer. Based on the data from the 100% CB half cells, the contribution of CB in $NaCrO_2$ half cells can then be estimated. For example, for B3 cells with 30 wt.% CB we can first subtract the total capacity of the cathode by the capacity derived from the given amount of CB in the cathode (i.e., 30 wt.% CB). The resulting capacity after the subtraction is then divided by the weight of $NaCrO_2$ in the cathode to obtain the specific capacity of $NaCrO_2$. This estimation leads to 84 mAh/g-$NaCrO_2$ after consideration of the CB contribution for B3 cells with 30 wt.% CB, while the specific capacity becomes 102 mAh/g-$NaCrO_2$ if we assume no CB contribution (see Table 1 in the article).