Rate dependent performance related to crystal structure evolution of $Na_{0.67}Mn_{0.8}Mg_{0.2}O_2$ in a sodium-ion battery.

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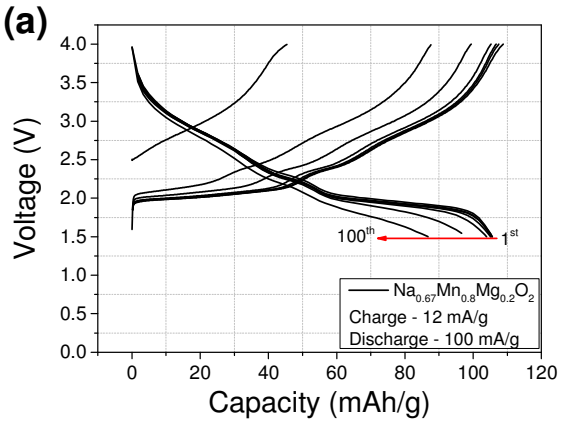
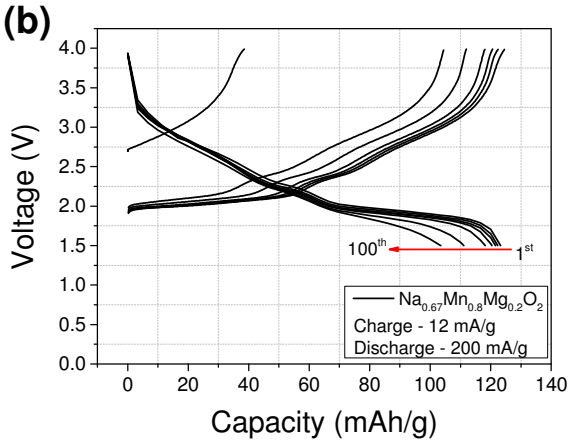
Supporting Information

Loading variability - 1.13, 3.17 and 1.10 mg active material loadings were used for the discharging rates of 100, 200 and 400 mAh/g in Figure S1 and S2 below, showing an apparent electrochemical enhancement at the 200 mAh/g discharge rate.





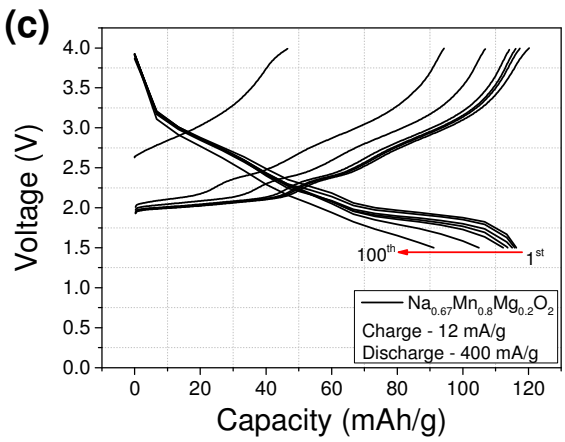


Figure S1. The potential profiles of the $Na_{0.67}Mn_{0.8}Mg_{0.2}O_2$ electrode charged at 12 mA/g and discharged at (a) 100, (b) 200 and (c) 400 mA/g. Profiles for the 1st, 2nd, 5th, 10th, 20th, 50th and 100th cycles are shown.

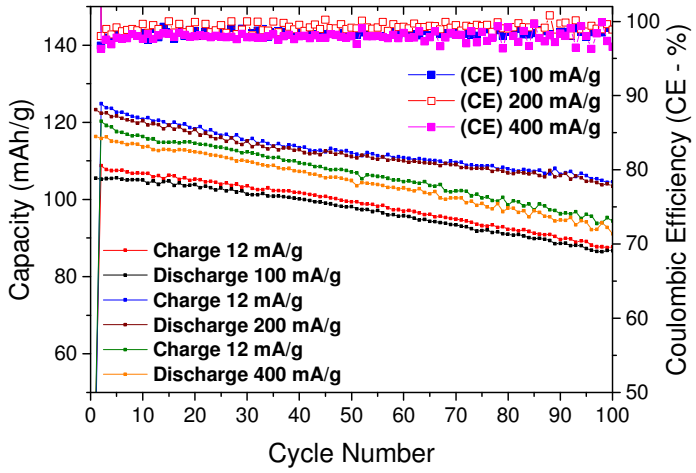
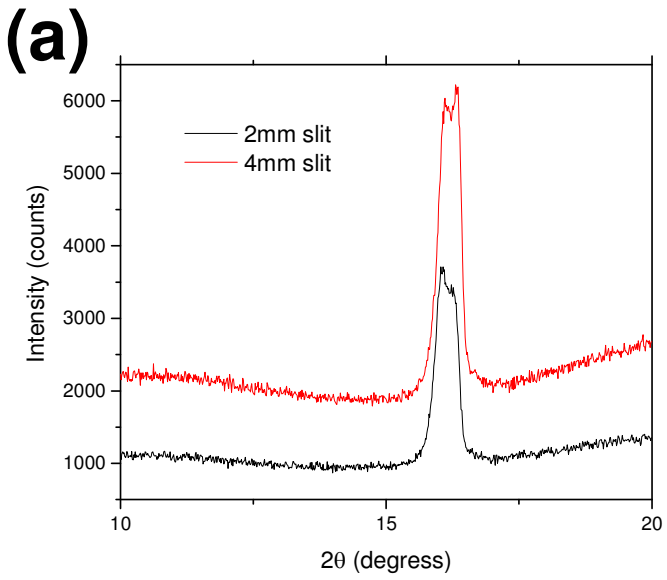
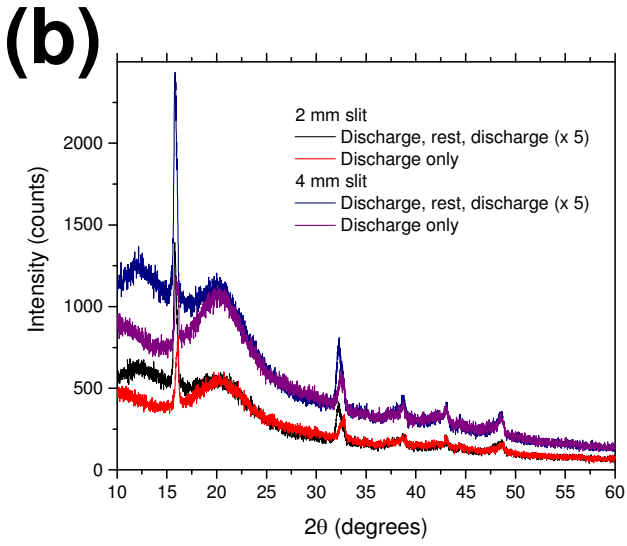


Figure S2. The capacity retention and Coulombic efficiency at 12 mA/g charge and 100, 200, 400 mA/g discharge rates.

To test for differences between the central Kapton-tape covered part of the *in situ* cell and the outer part, the *in situ* cells were cycled offline, electrodes extracted and analysed using a laboratory XRD with controllable incoming X-ray beam slit sizes. It is also worthwhile to note that the Kapton-tape covered hole in the *in situ* cells is 3 mm in diameter and the X-ray beam dimensions used at the Australian Synchrotron Powder Diffraction beamline was 1.3 x 2 mm.





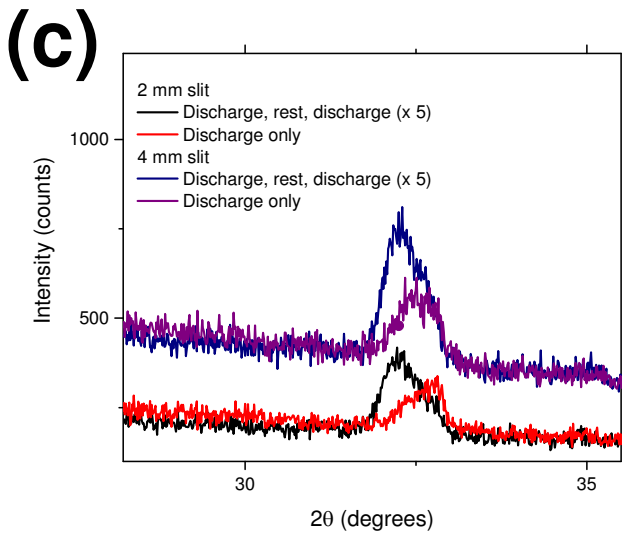
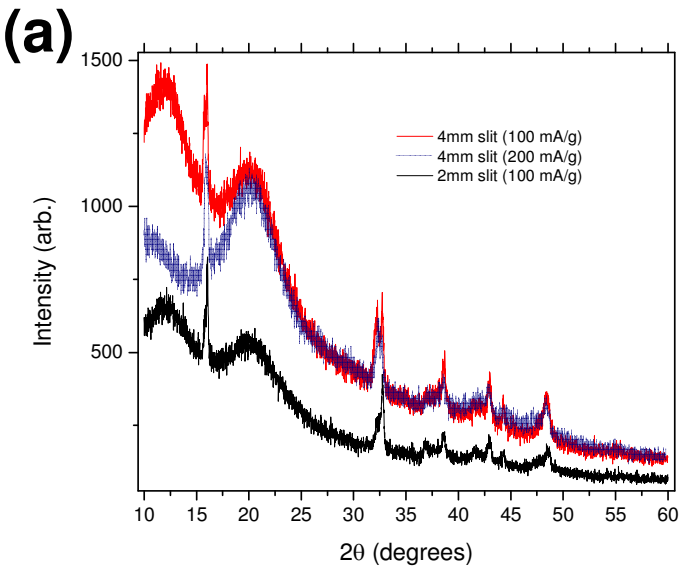


Figure S3. As collected XRD patterns from electrodes extracted from an *in situ* cell that was charged at 12 mA/g and discharged at 200 mA/g. Two sets of sequences are tested, the first is a discharge-rest-discharge and this is repeated 5 times while the second is a straight discharge followed by extraction. The difference between smaller and larger slits is shown in (a) for the first case with the 002 reflection ($P6_3/mmc$ and $Cmcm$) while (b) shows both the first and second case with the small and large slits and (c) shows the 004 reflection ($P6_3/mmc$ and $Cmcm$).



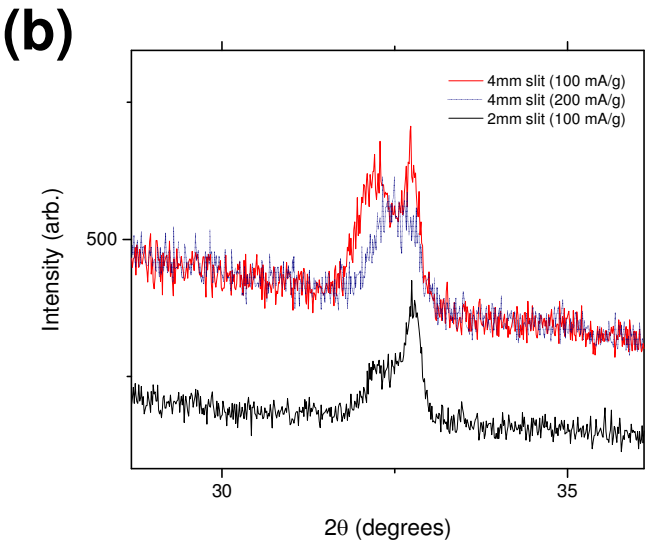


Figure S4. (a) As collected XRD patterns from electrodes extracted from an *in situ* cell that was charged at 12 mA/g and discharged at 100 mA/g (and 200 mA/g in grey – also shown in Figure S3). For the 100 mA/g case a straight discharge is applied followed by extraction. The difference between smaller (black) and larger (red) slits is shown in (b) for the 004 reflection ($P6_3/mmc$ and *Cmcm*) with a subtle preference for the $P6_3/mmc$ phase with wider slits (i.e., the reflection at $2\theta \sim 31.2$ compared to the reflection at $2\theta \sim 31.8°$).