Supplementary Data:

Synthesis of Mg NCM-622:

The $LiNi_{0.6}Co_{0.2}Mn_{0.17}Mg_{0.03}O_2$ (Mg NCM-622) is synthesised by the co-precipitation method using the continuous stirred tank reactor (CSTR). The transition metal solution comprises 2M of nickel (II) sulfate hexahydrate ($NiSO_4 \cdot 6H_2O$), cobalt (II) sulfate heptahydrate ($CoSO_4 \cdot 7H_2O$), and manganese (II) sulfate ($MnSO_4 \cdot H_2O$) and magnesium sulfate monohydrate ($MgSO_4$) with a molar ratio of 0.6:0.2:0.17:0.03 and 4M sodium hydroxide (NaOH) solution to adjust the pH and 0.2 M of ammonia solution (NH_4OH) as a chelating agent. The solutions of TM were fed into the CSTR of 1 L capacity with a feeding rate of 300 mL h^{-1} and NH_4OH at the rate of 30 mL h^{-1} and NaOH in contact mode to adjust the pH. The reaction was carried out at the temperature of 50 °C, and the gradual variation of pH value from 11.0 to 10.6 influenced the morphology of primary particles. The obtained $Ni_{0.6}Mn_{0.17}Co_{0.2}$ $Mg_{0.03}(OH)_2$ precursor was washed several times with the DI water and then filtered and dried at 80 °C for 12 h. Finally, the dried precursor and LiOH were mixed with stoichiometric amounts of 1:1.02 and calcined at 450°C for 5hrs and 780°C for 18 h in an O_2 atmosphere to get $LiNi_{0.6}Co_{0.2}Mn_{0.17}Mg_{0.03}O_2$ (Mg NCM-622).

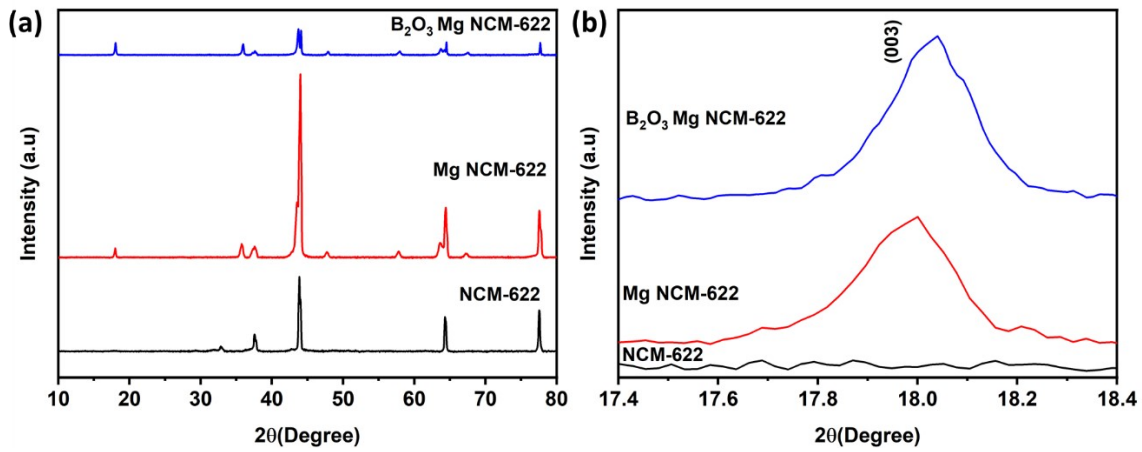

Figure S1: Ex-situ XRD patterns of cycled electrodes after 100 cycles at 4.5 V (55 °C)

Figure S2: Electrochemical Impedance Spectroscopy Analysis of NCM-622 and BMNCM-622 Cathodes. (a) Before Cycling, (b) After Cycling