Effect of varying the chelating and precipitating agents volumes on $LiNi_{0.8}Mn_{0.1}Co_{0.1}O_2$ (NMC811)

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Overview

- Introduction
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- Conclusion

Introduction

Lithium-ion batteries (LIBs)

- Better cyclability
- High efficiency
- Good performance

Why Ni-rich electrode (NMC811)?

- High reversible capacities (~200 $mAh \cdot g^{-1}$)
- High voltage operation
- Lower thermal stability

Applications

Negi R.S., Elm M.T., 2022. Reproducible long-term cycling data of Al_2O_3 coated $LiNi_{0.70}Co_{0.15}Mn_{0.15}O_2$ cathodes for lithium-ion batteries. *Sci Data 9*, 127.

Aim

To investigate the effect of varying the volumes of the chelating (NH_4OH) and precipitating (NaOH) agents independently on NMC811nanopowders.

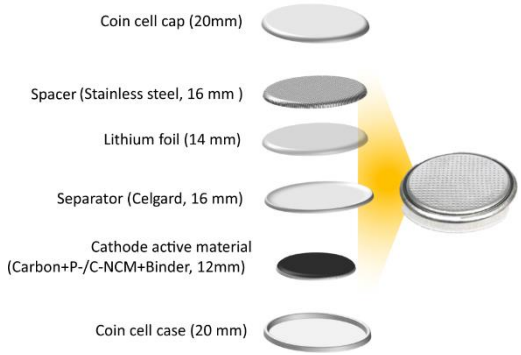
Effect studied are:

- Thermal stability
- Structure
- Morphology
- Electrochemical testing

Experimental

Two step synthesis method

- Co-precipitation
- Solid state



Characterization

- Nanopowders:
  - TGA, XRD, SEM, XPS, and FTIR
- Assembled to coin cell for electrochemical performance.

Negi R.S., Elm M.T., 2022. Reproducible long-term cycling data of Al_2O_3 coated $LiNi_{0.70}Co_{0.15}Mn_{0.15}O_2$ cathodes for lithium-ion batteries. *Sci Data 9*, 127.

Results

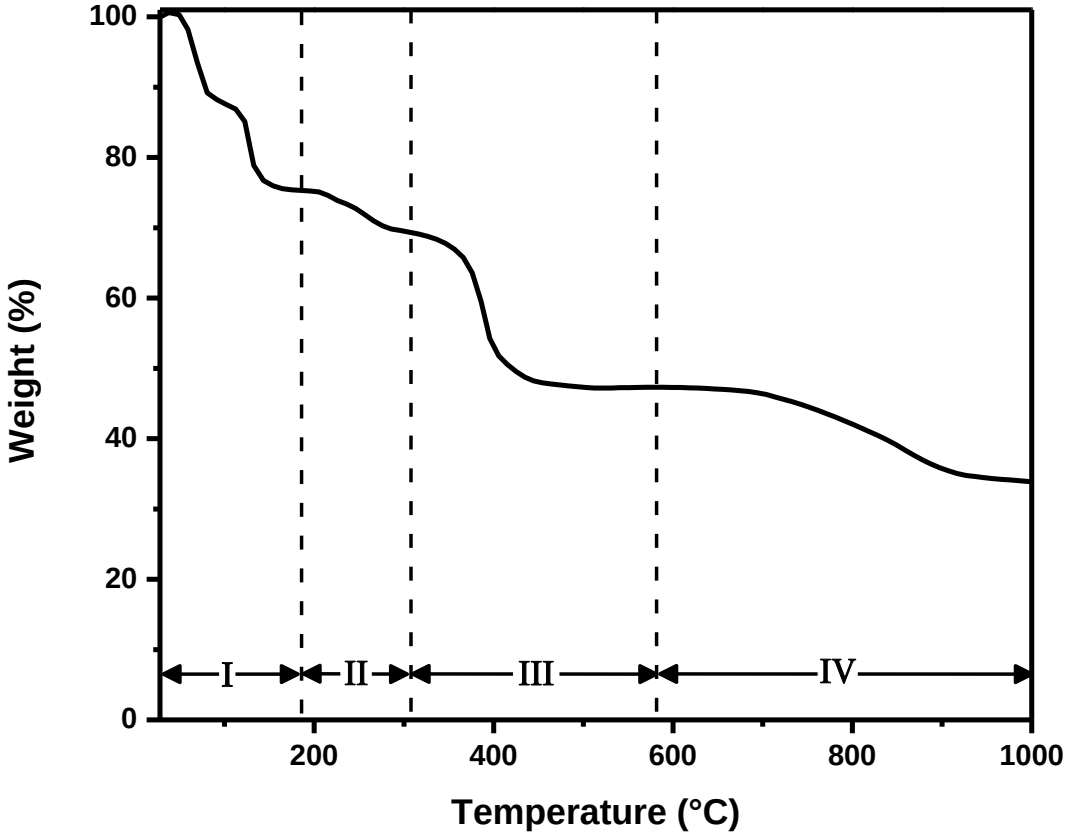
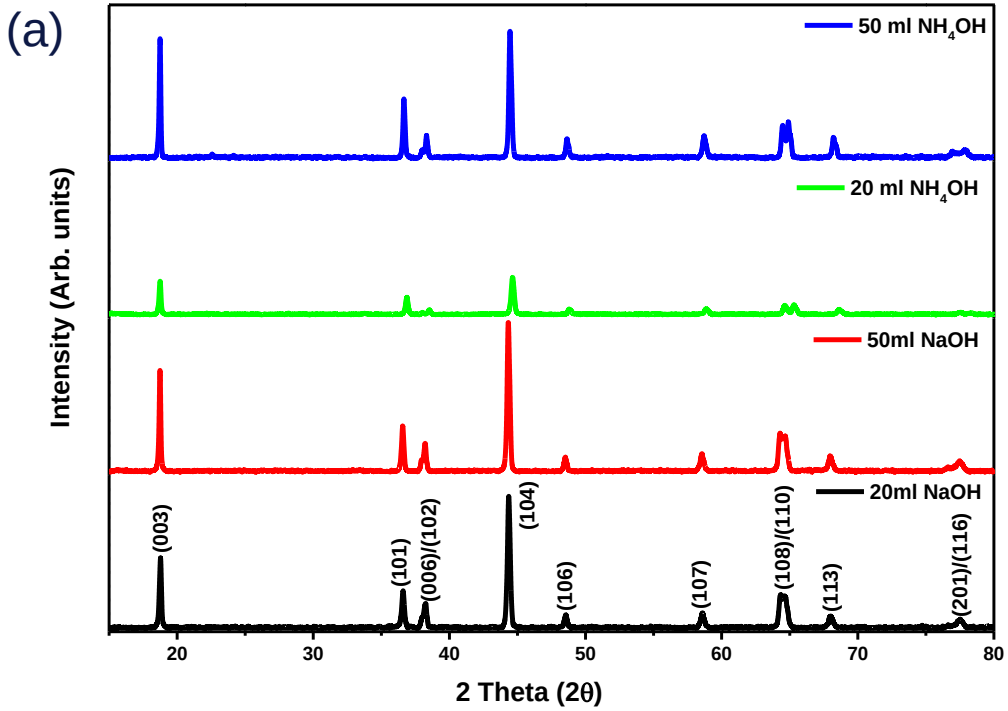


Fig. 1: TGA for the thermal decomposition of the 20 ml NH_4OH sample.



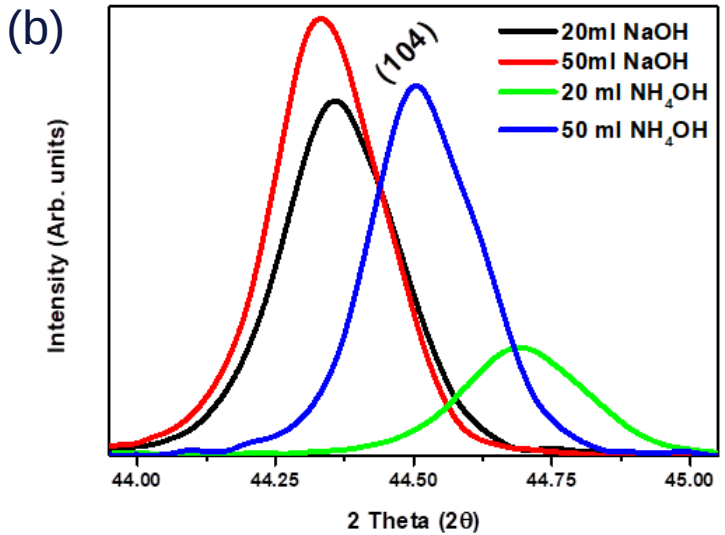


Fig. 2: (a) The diffraction patterns and (b) (104) diffraction peaks for the NMC811 samples with different volumes of the chelating and precipitating agents.

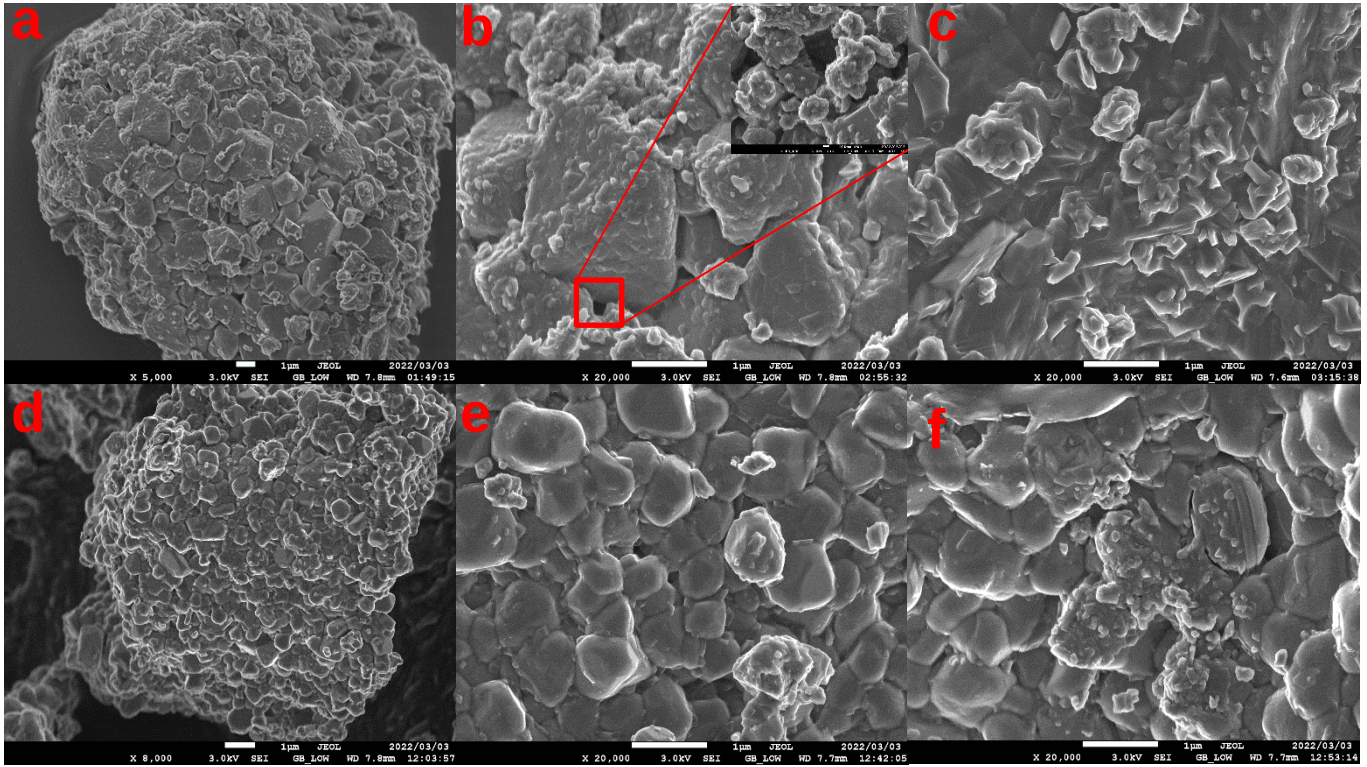


Fig. 3: The SEM images for 20 ml of (a) NH_4OH, (b) NaOH, at low magnification, and (b) 20 ml, (c) 50 ml of NH_4OH, and (e) 20 ml, (f) 50 ml of NaOH at high magnification, correspondingly.

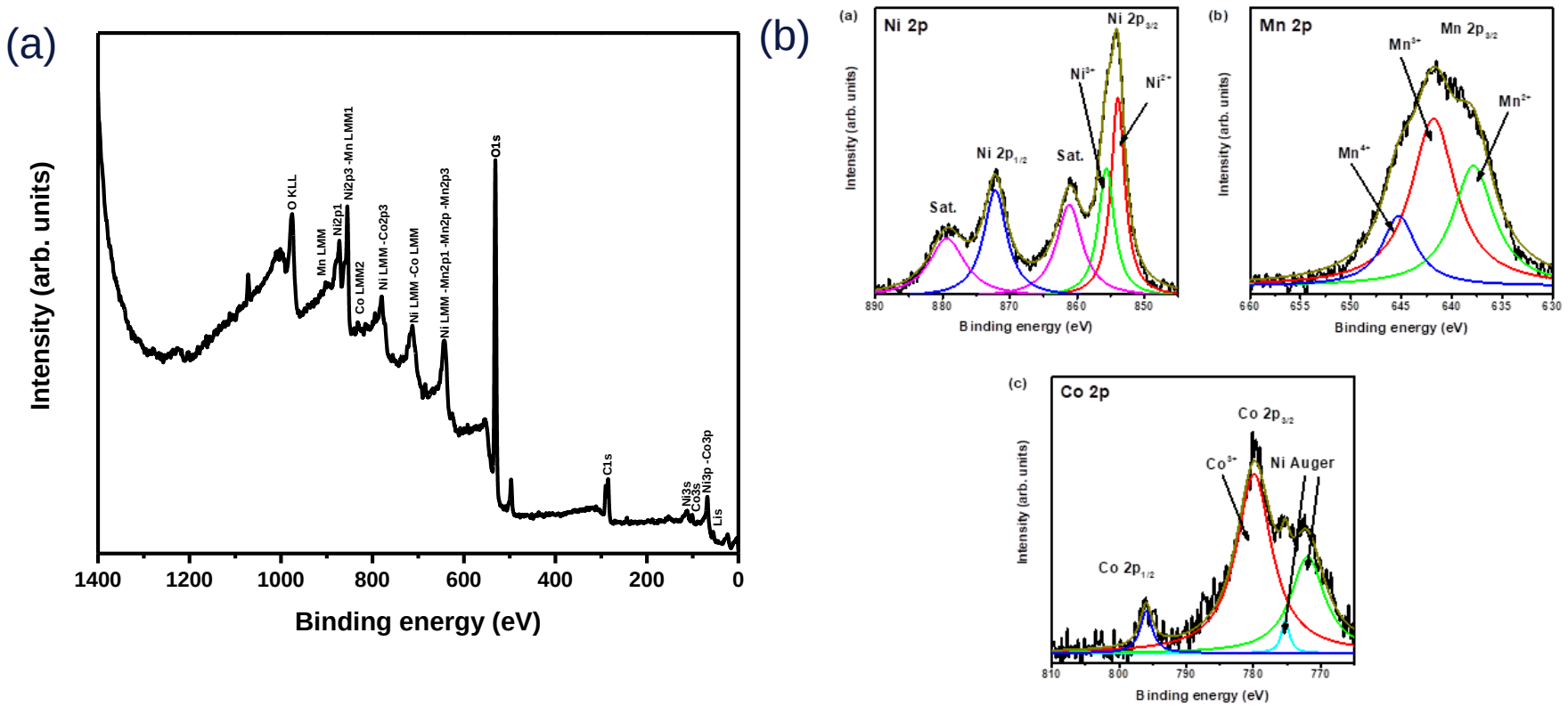


Fig. 4: (a) The survey spectra and (b) High-resolution XPS spectra of Ni, Mn, and Co 2p for 20 ml NH_4OH sample.

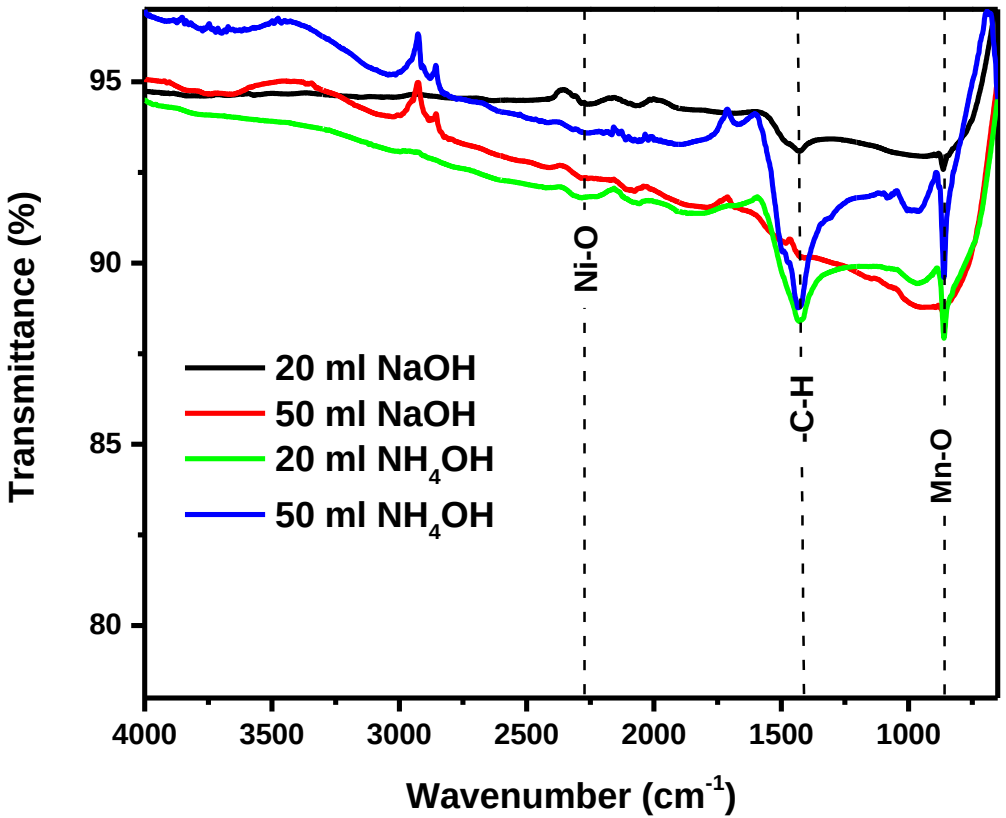


Fig. 5: The FT-IR spectra of NMC811 nanopowders.

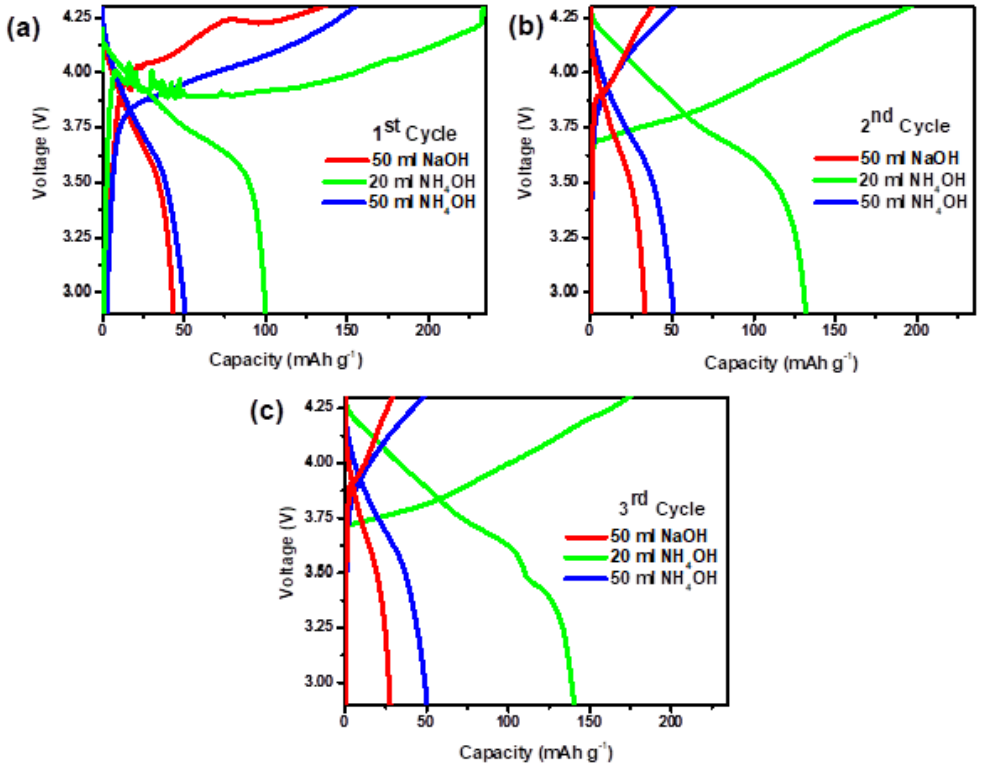


Fig. 6: The voltage profiles of the prepared NMC811 for (a) first, (b) second and (c) third cycle at the rate of 0.1 C.

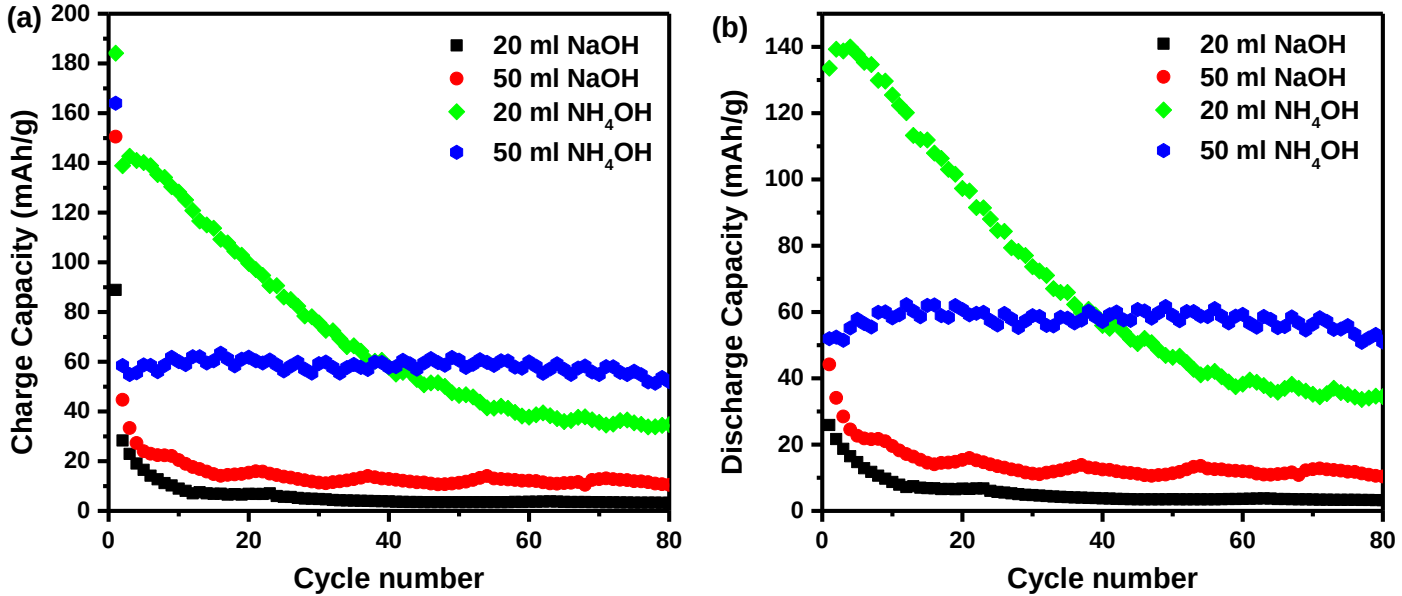


Fig. 7: The galvanostatic (a) charge and (b) discharge of the NMC811 and Cu-NMC811 samples at 0.1 C.

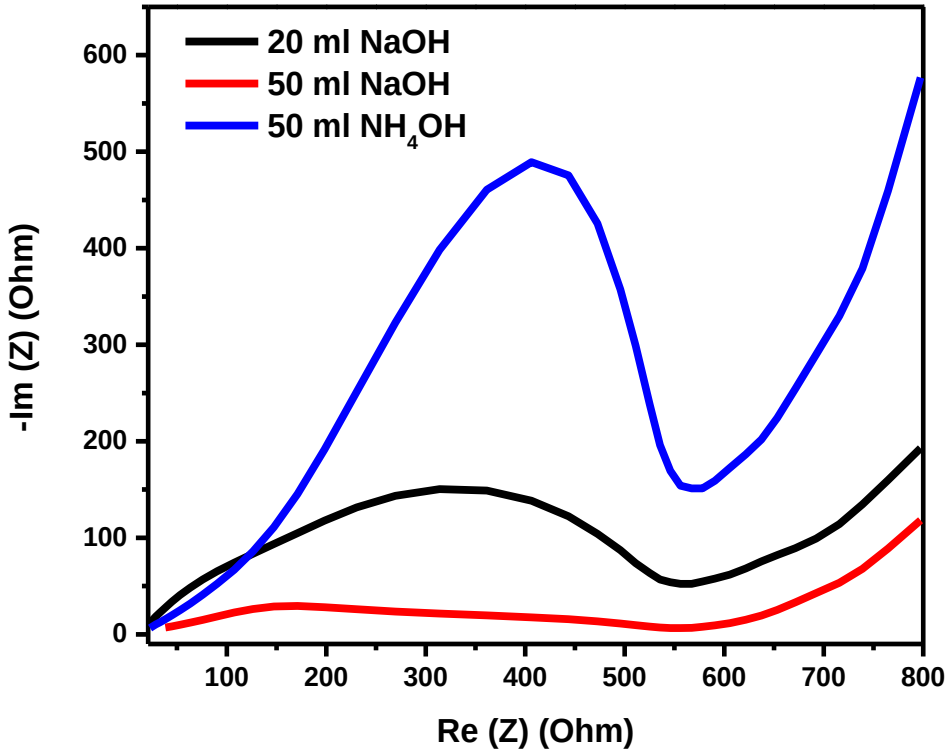


Fig. 8: The Nyquist curves of the MNC811 nanopowders.

Conclusion

- TGA showed that NMC811 stable when annealed with temperatures ~850 ℃.
- XRD revealed that crystallite size was slightly increased with increasing volumes of both the chelating and precipitating agent.
- SEM showed quasi-spherical shaped particles at low magnification.
- XPS displayed the presence of Li, Ni, Mn, and Co on the surface of the prepared nanopowders.
- FTIR confirmed bending modes originating from the NMC.
- Electrochemical results revealed that chelating agent greatly affects the electrode activity as opposed to the precipitating agent.

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Thank you

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