DEVELOPMENT OF NMC CATHODE POWDER WITH CORE/SHELL MORPHOLOGY FOR LONG CYCLE LIFE LIB BATTERIES

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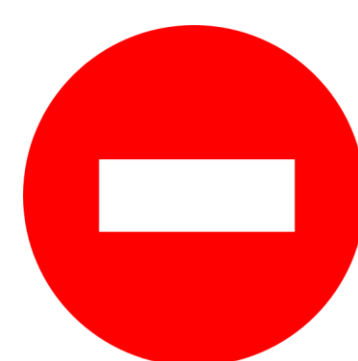
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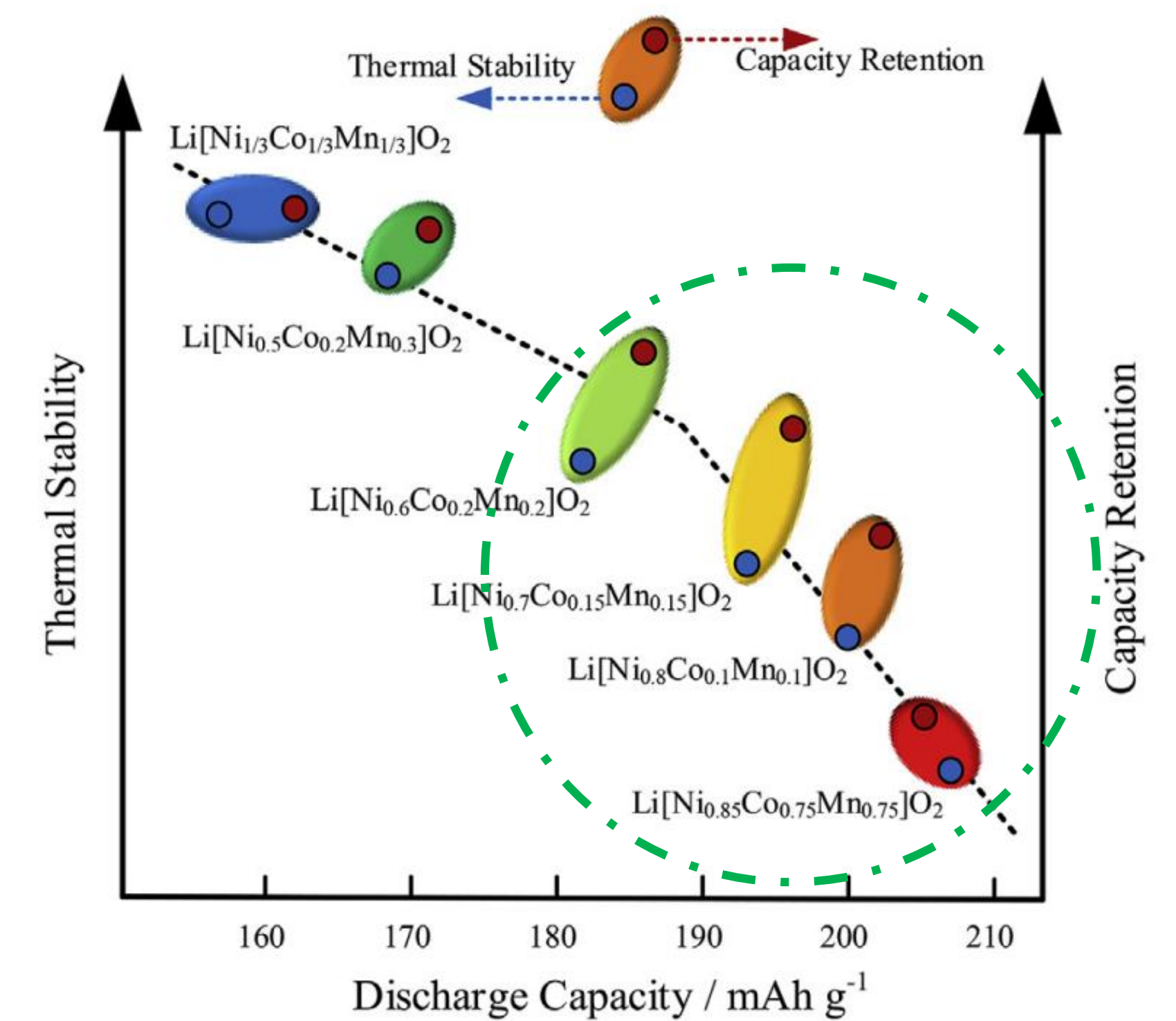*Bilge.Saruhan@dlr.de

Benefits and Obstacles of Ni-rich Cathodes in LiBs

+ + High energy density
+ Increased storage capacity
+ Contribution to the circular economy (durability, recyclability and possibility of second life)

– - Thermal stability
- Insufficient cycle life
- Nickel oxidation
- Capacitance reduction

Development of Core/shell-structured NMC Cathode Powders for sustainable LiBs with longer cycle life

NMC 90 Core

NMC 622 Shell
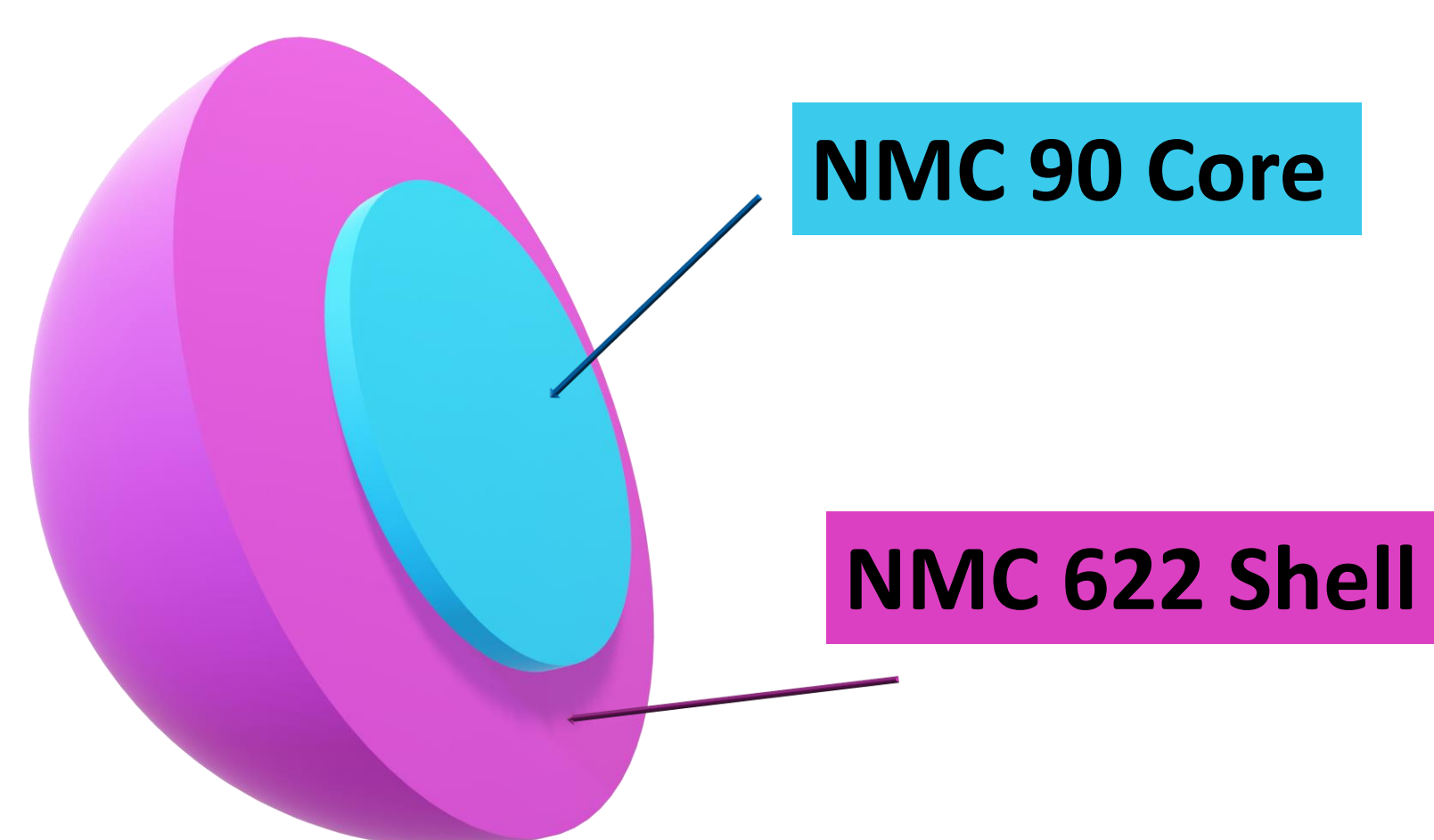
- High energy density
- Increased storage capacity
- Reduced use of critical Co

- Improved structural stability
- High thermal stability

## Oxalate assisted co-precipitation method for synthesis

1. Dissolving Ni-, Mn-, and Co-acetates in water in the NMC 90 proportion
2. Adding oxalic acid as a co-precipitation agent
3. Drying and calcinating at 850°C
4. Repeating steps 1–3 to prepare shell-solution in the NMC 622 proportion
5. For shell coating, adding NMC 90 core to the shell solution after the step 1 as an extra step

Microstructural characterization of calcined powder at 850°C

NMC90

NMC622
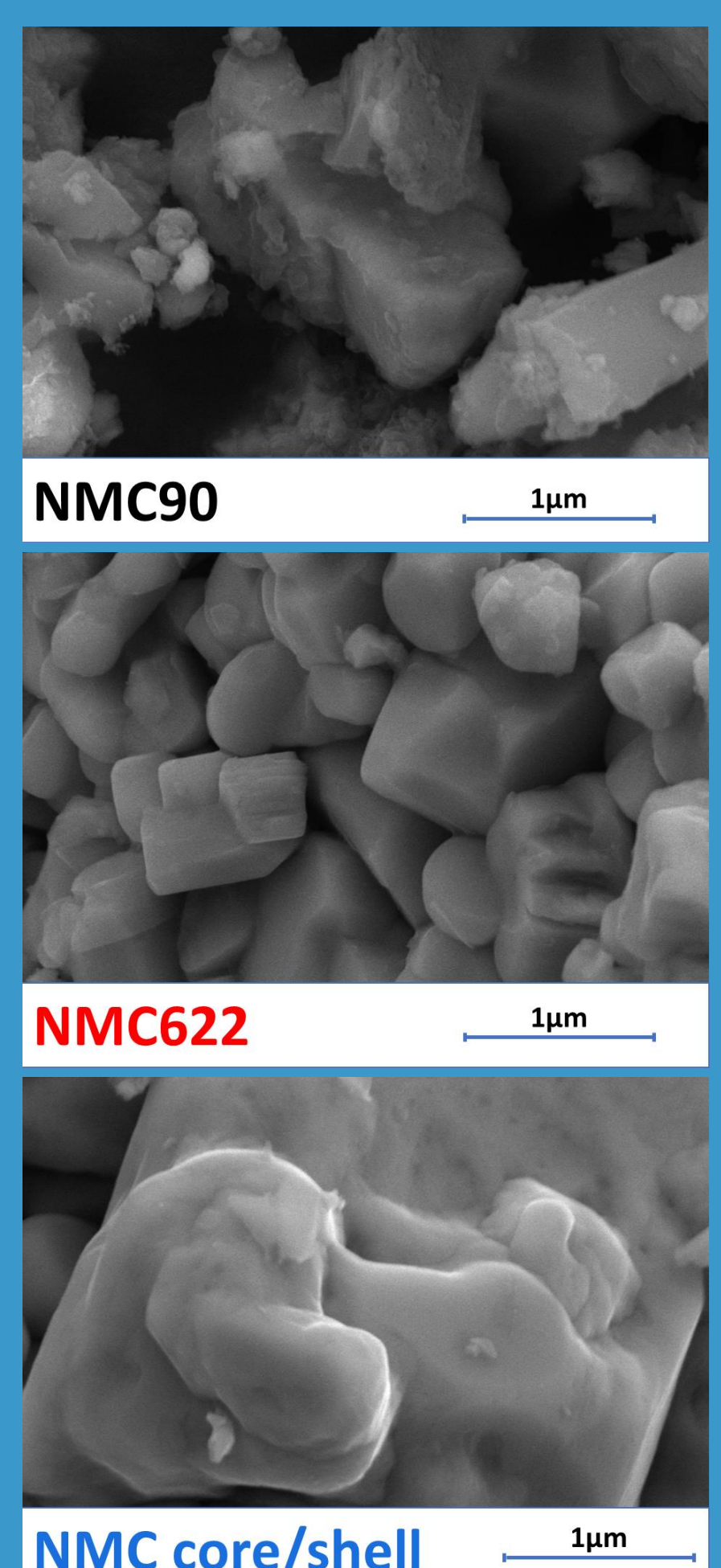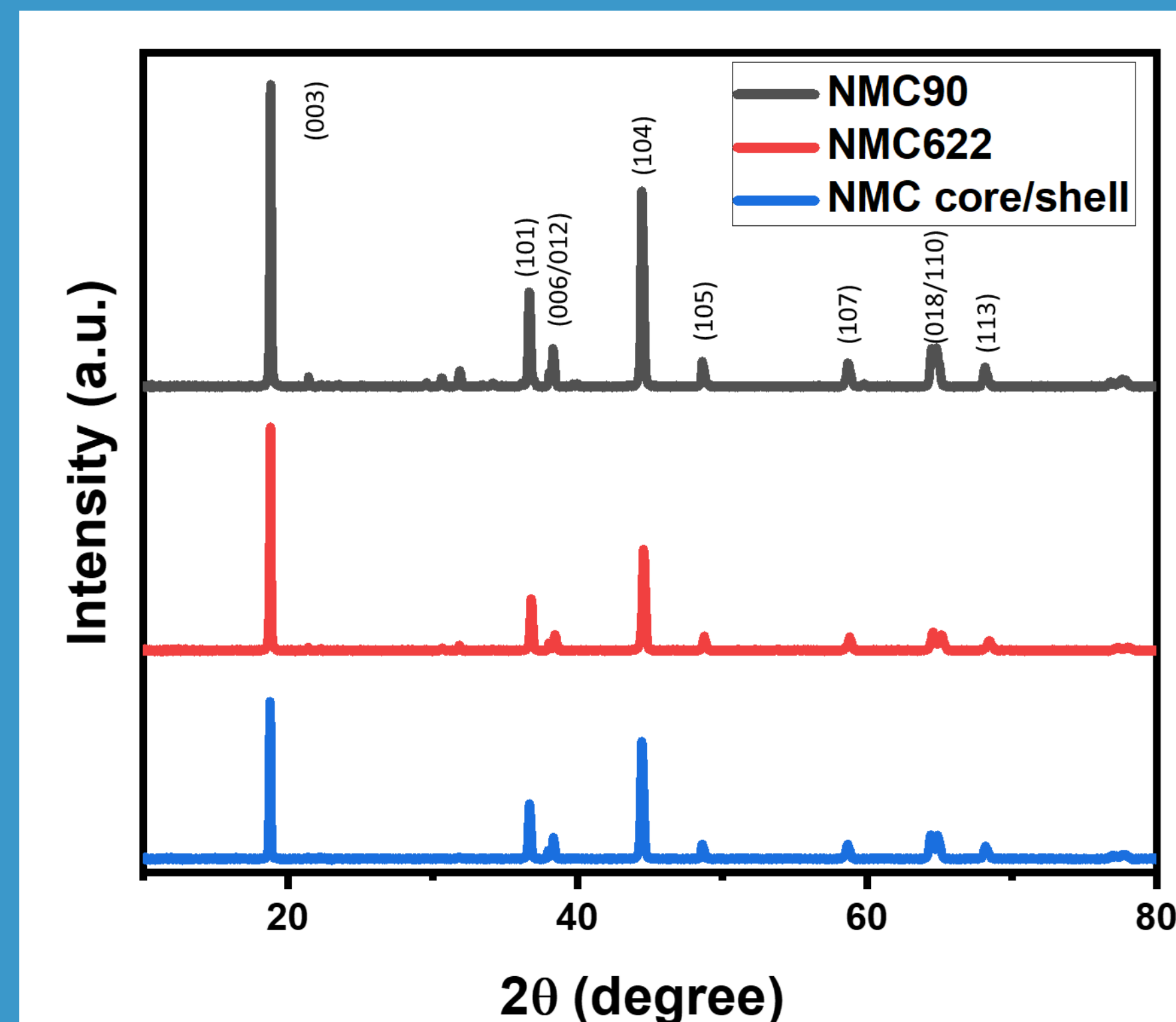
NMC core/shell

Electrochemical performance characterization
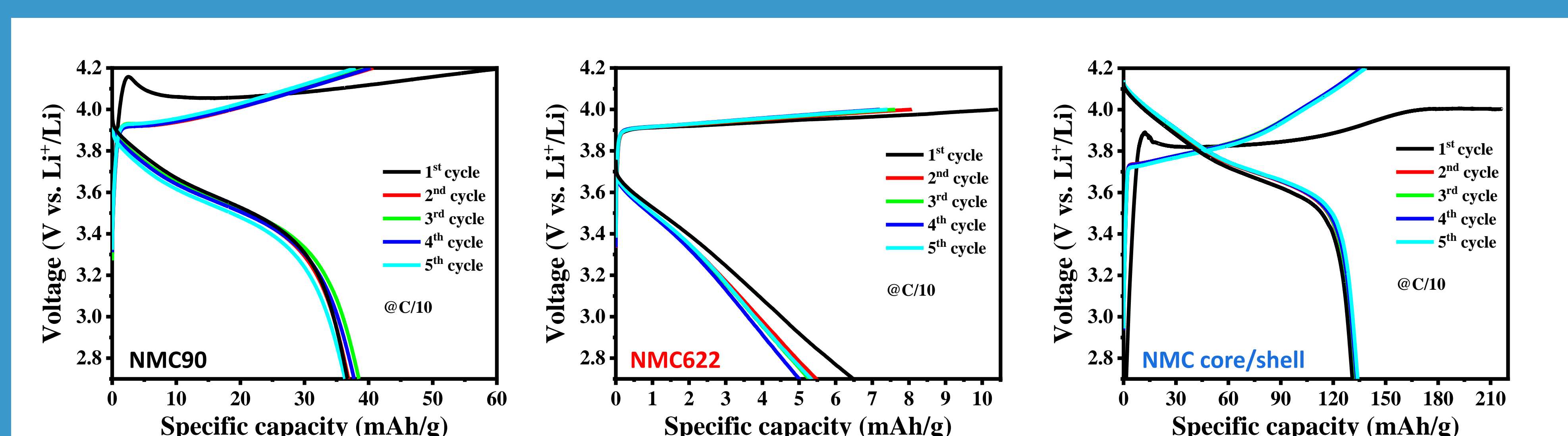
- Half-cells with NMC core/shell cathodes based on NMC 90 core and NMC 622 shell, Li anodes and Glass Fiber-separators are used for GCD tests
- NMC 90, NMC 622 and NMC core/shell delivers a first discharge capacity of ~37 mAh/g, ~6.5 mAh/g and 131 mAh/g at C/10, showing stable performance over five cycles, while NMC 622 experiences a capacity loss with each subsequent cycle
- First charge capacity is higher than first discharge capacity, indicating partial Li-ion loss during cycling
- This core/shell cathode powder with NMC 90 as core and NMC 622 as shell provides a promising cathode material for Li-ion Batteries

References:
Nisa S.S. et al. Batteries 2022, 8:4
Han et al. eTransportation 2019, 1: 100005