

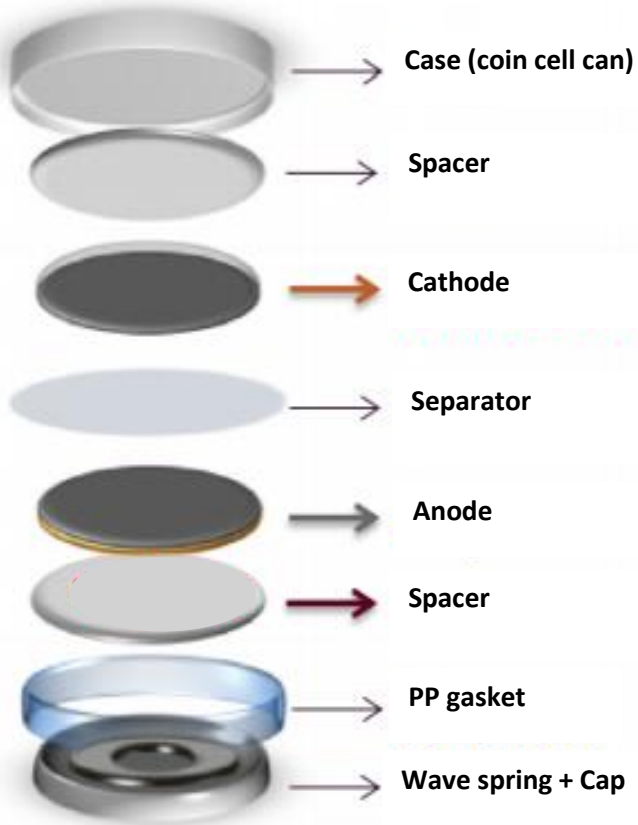


# STANDARDIZED ASSEMBLY PROCEDURE

LRCS – Training sessions from Sept. 27<sup>th</sup> to Sept. 29<sup>th</sup> 2021

# ASSEMBLY STEPS

## Assembly of components



## Cell closing



Cell crimping ensures air tight system.

## Cell testing





# STAKES of THE FORMATION

Assemble standardized coin cells within BIG-MAP project

## Cell design

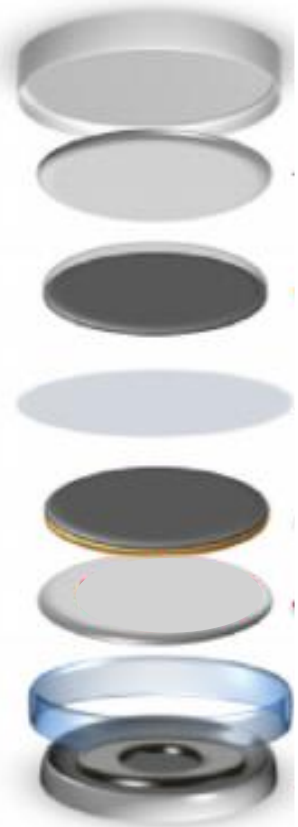
- Component order
- Correct internal pressure

## Component parameters

- Electrode size
- Electrolyte volume

HOMOGENEOUS DATA

# Lever 1: INTERNAL PRESSURE

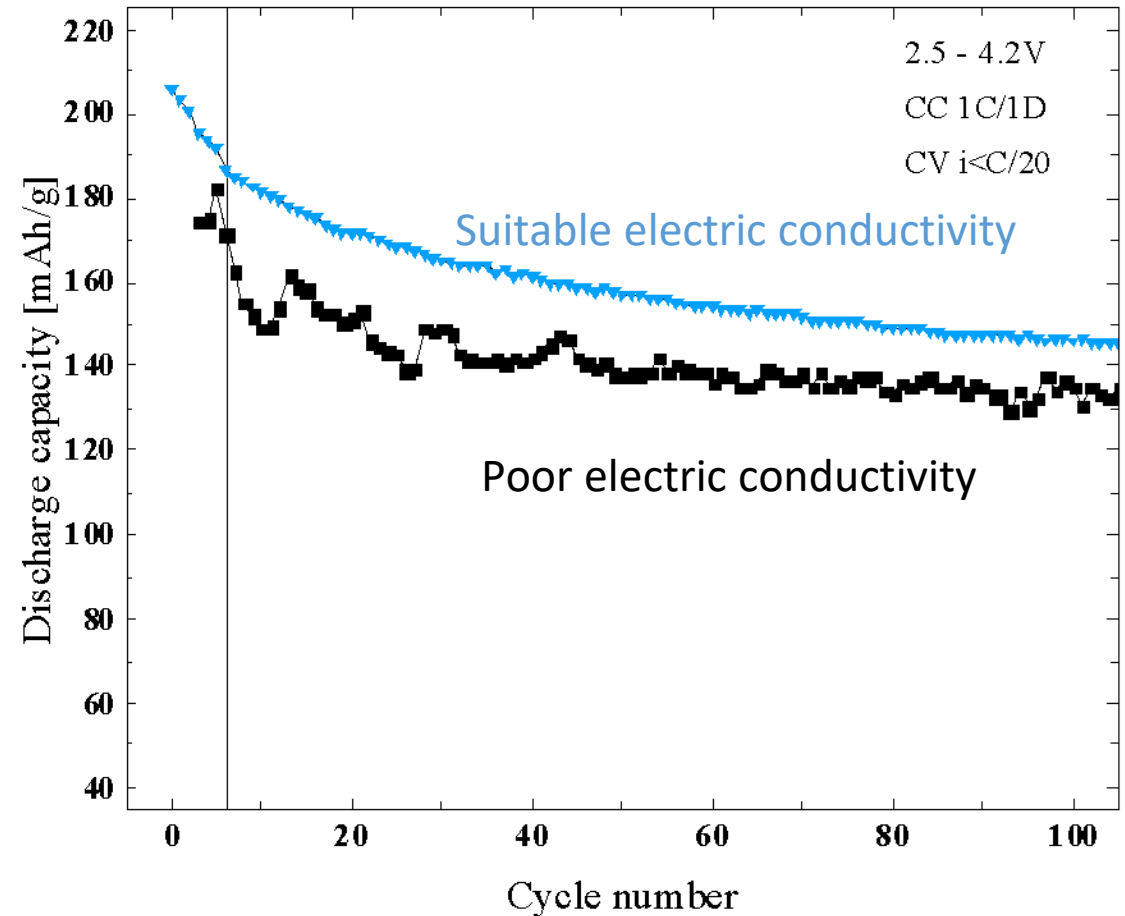


Minimum internal gap to fill = 2.9 mm\*

Thickness of crimped cell = 3.1 mm

**Total stack height**  
**>**  
**Height of crimped cell**

LiNiO<sub>2</sub> – Graphite – LP57



\*: empirical value



# Lever 1: INTERNAL PRESSURE

	Coin cell component	Used quantity	Single component height [μm]
Chemistry	Anode (Current collector + coating) [μm]	1	39
	Separator [μm]	1	25
	Li	0	380
	Cathode (Current collector + coating) [μm]	1	35
Cell components	Conical spring [μm]	1	1200
	Stainless steel spacer [μm]	2	700
	Wave spring [μm]	0	1200
Cases	Positive case bottom thickness [μm]	1	252
	Negative can with gasket bottom thickness [μm]	1	274
	Total 2032 coin cell height [μm]	///	3100

Ours:1200 μm  
Ours:477 μm

Ours:245 μm  
Ours:262 μm

NMC811 – 1 mAh/cm<sup>2</sup>

Graphite – 1.1 mAh/cm<sup>2</sup>

**Our case: Stack height: 2320 μm Empty cell Height: 2393 μm**

Ours:0.96μm

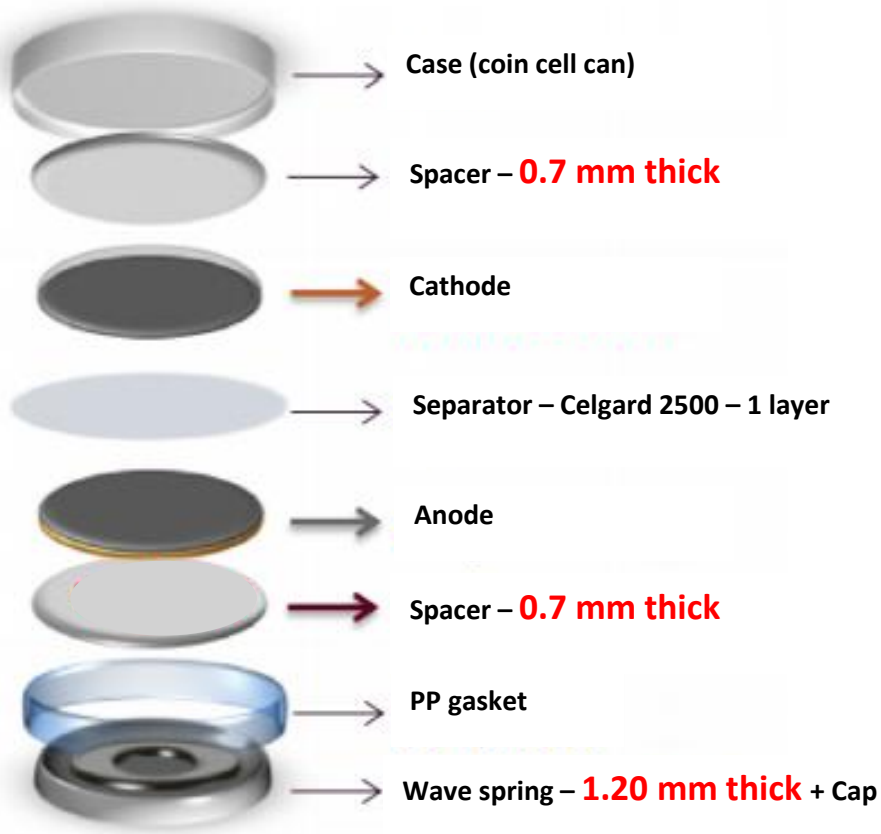
1.03 < Ratio < 1.1

Total thickness [μm]	3025
Stack height / Empty cell height	0.98
Comment	Target not met - Stack height is too low

Total thickness [μm]	3225
Stack height / Empty cell height	1.04
Comment	Target met - Stack height is OK



# Lever 1: INTERNAL PRESSURE – ASSEMBLY ORDER



Assmuming

1. total electrode thickness equals to 419  $\mu\text{m}$
2. Celgard 2500 thickness = 25  $\mu\text{m}$

Total thickness [ $\mu\text{m}$ ]	3225
Stack height / Empty cell height	1.04
Comment	Target met - Stack height is OK



# Lever 1 - COMPONENTS

## BIG-MAP standards

Acceptable range 104 - 110%

**Adjust height with components of our choice**

Component	Thickness
Spacer	1 mm
Spacer	0.5 mm
Wave spring	1.42 mm
Positive can	0.250 mm
Negative can	0.275 mm



# TOB

***XIAMEN TOB NEW ENERGY TECHNOLOGY CO., LTD.***

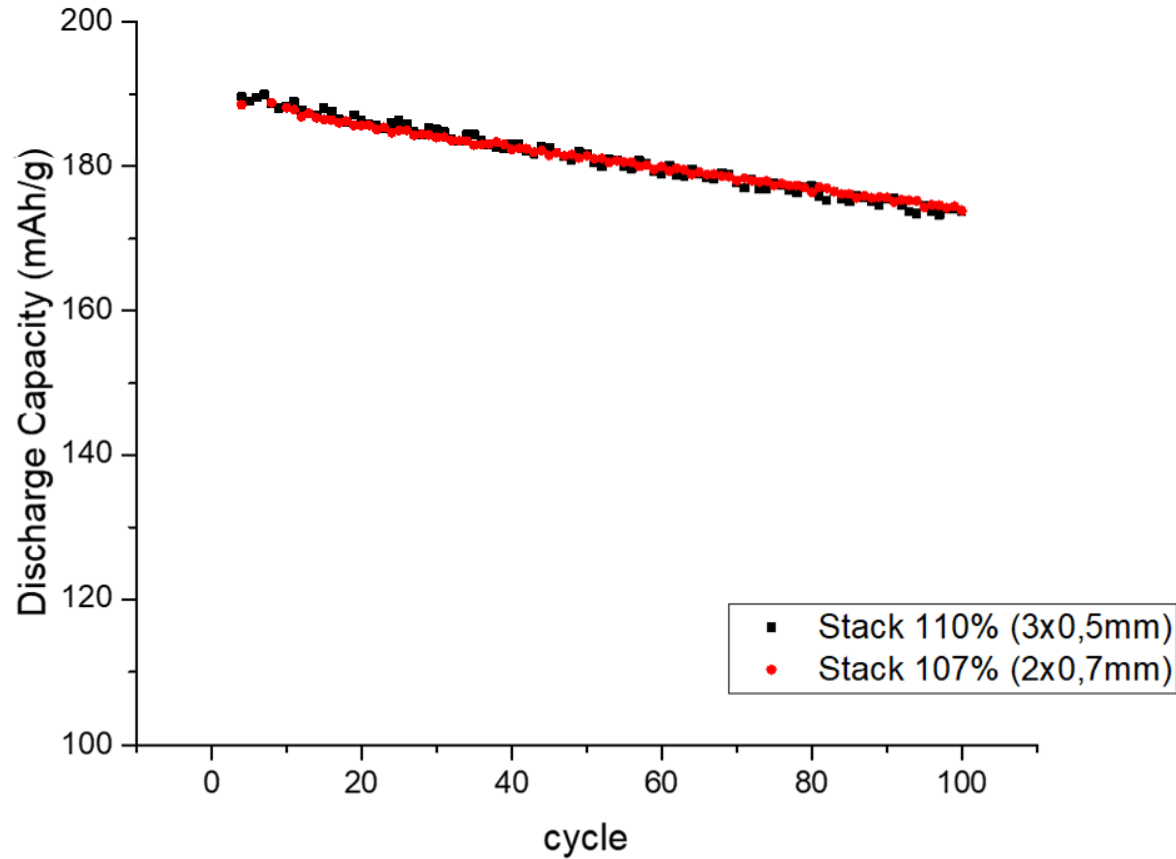
Provide A Full Set Of Solutions For Battery Machines.

SALES

[tob.amy@tobmachine.com](mailto:tob.amy@tobmachine.com)

# Lever 1: INTERNAL PRESSURE

NMC811 vs Gr 3mAh/cm<sup>2</sup> 25°C 2,5V - 4,2V 1C, i<C/20, 1D



## BIG-MAP standards

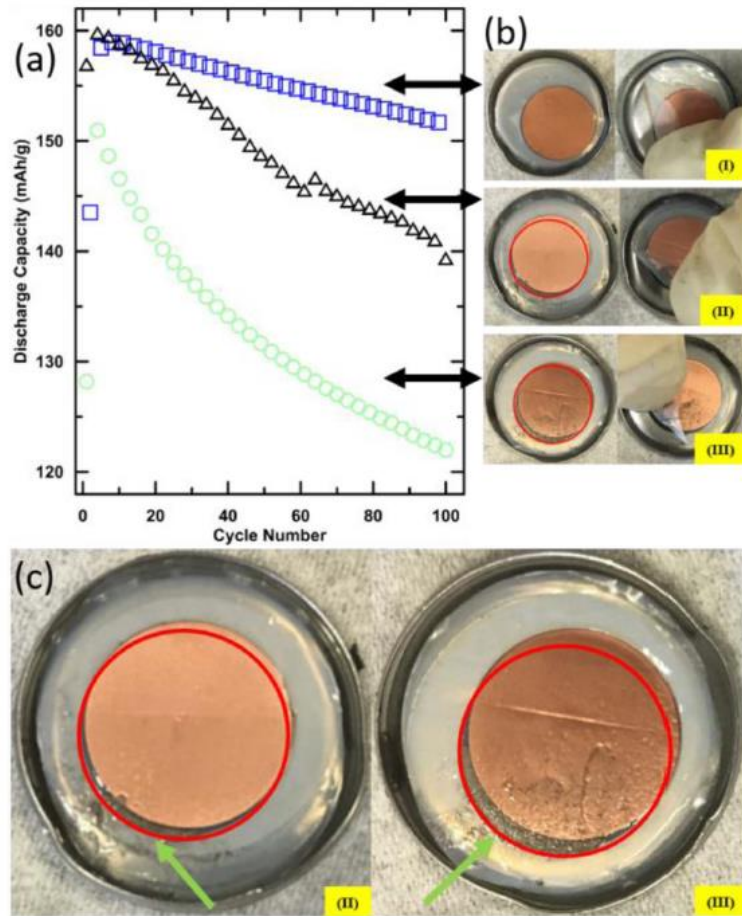
Acceptable range 104 - 110%

Adjust height with components  
of our choice

**Caution: better to avoid spacer  
stacking**



# Lever 2: ELECTRODE SIZES

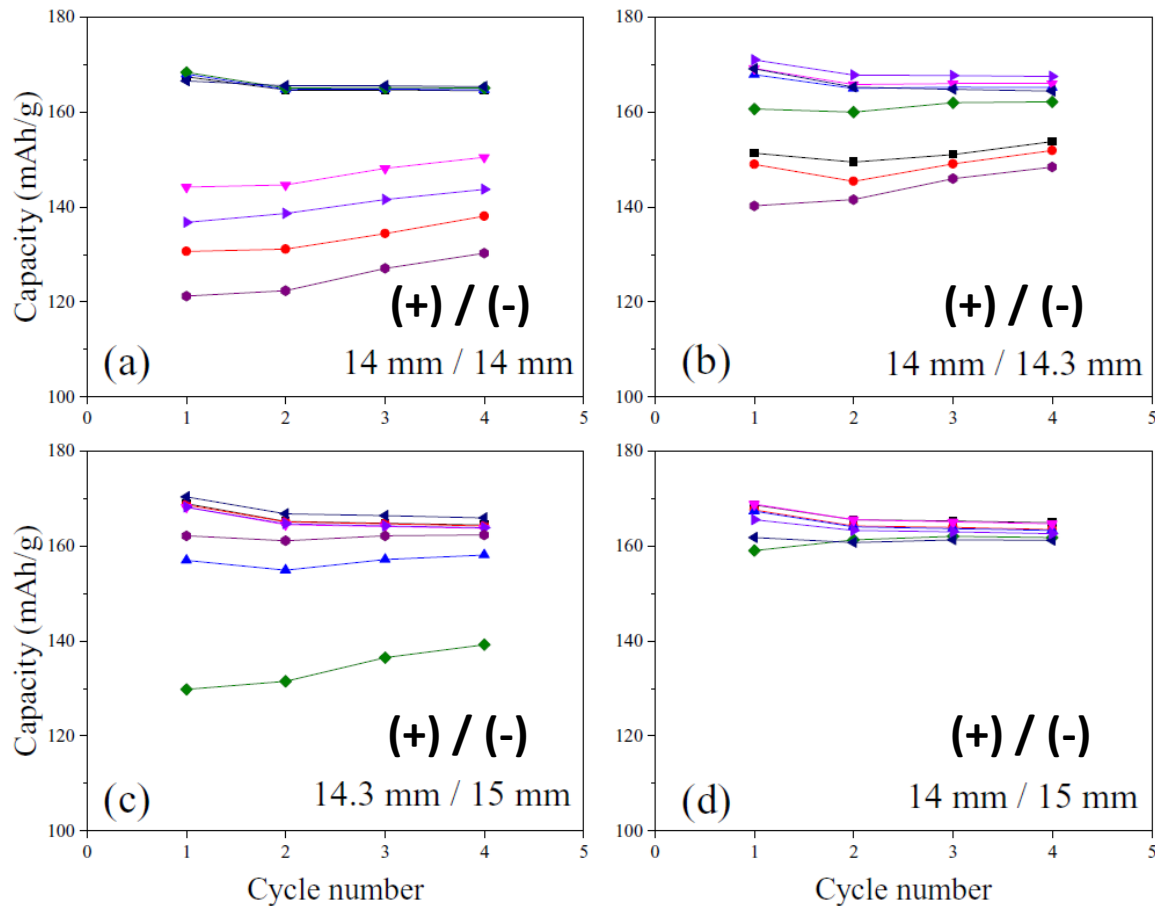


Misaligned electrodes precipitate the end of the cell life

Same electrode sizes = easier to misalign

# Lever 2: ELECTRODE SIZES

Discharge Capacity vs Cycle Life



Slightly oversized anode  
?  
 more repeatable results

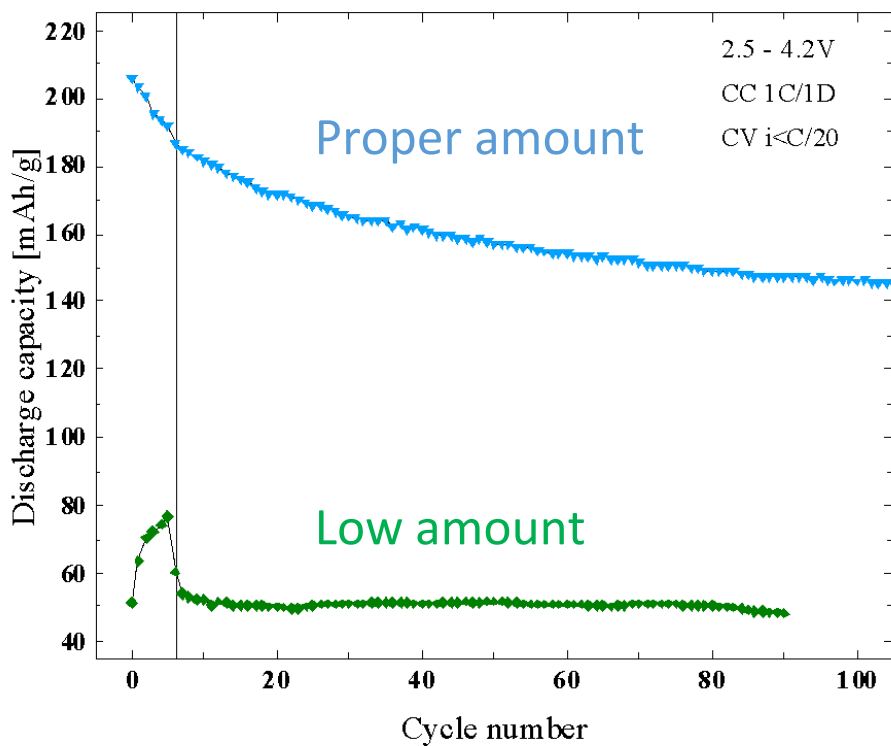
**BIG-MAP standards**  
 15 mm diam. anodes  
 14 mm diam. cathodes

NMC532 Vs Graphite

# Lever 3: ELECTROLYTE VOLUME

## NOT ENOUGH

Poor electrode wettability



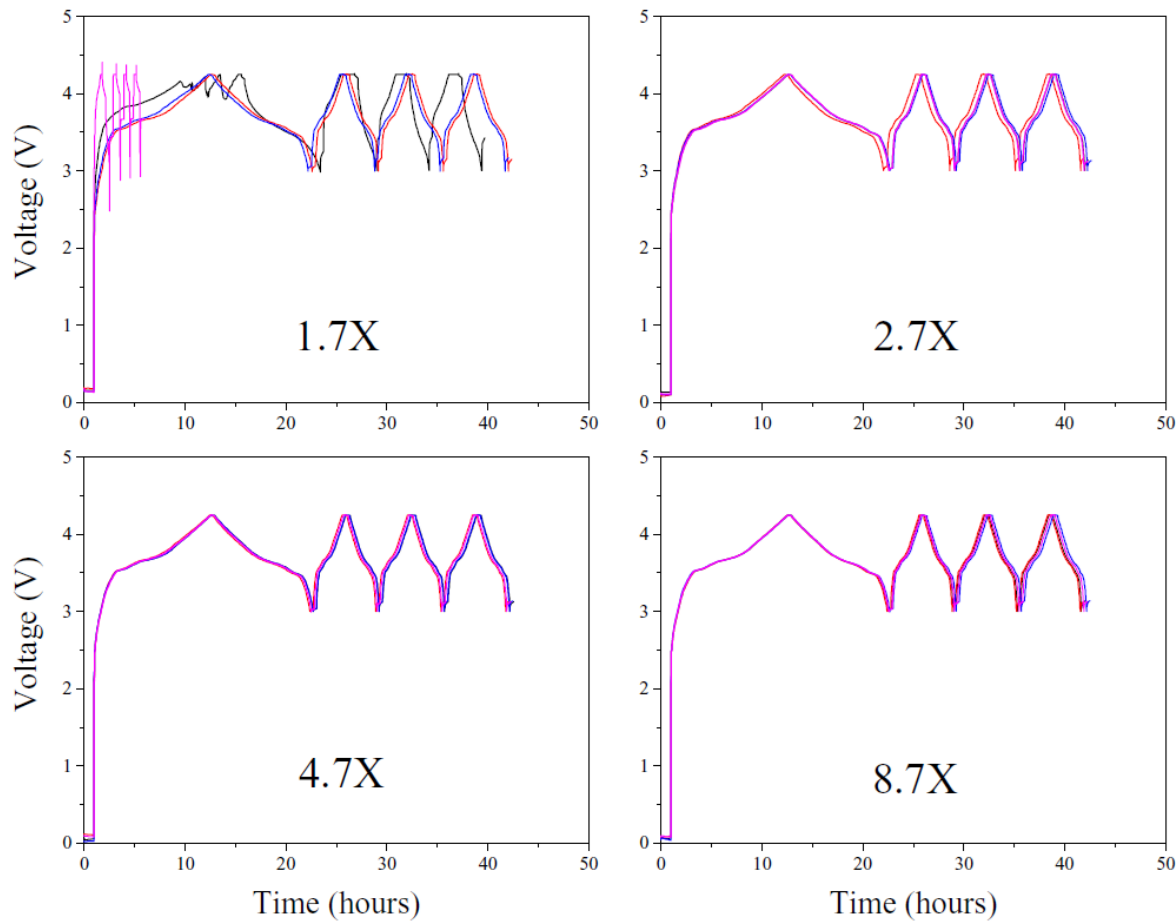
## LARGE AMOUNT

- Increases SEI dissolution
- Boosts cell performance
  - Moves away from industrial applications

HOW MUCH ?



# Lever 3: ELECTROLYTE VOLUME



**BIG-MAP standards**  
4.0 times total porosity

NMC532 Vs Graphite

# Lever 3: ELECTROLYTE VOLUME

NMC811 – 1mAh/cm <sup>2</sup> Graphite – 1.1 mAh/cm <sup>2</sup>	Current collector thickness [μm]	Total electrode thickness Current collector + coating [μm]	Coating porosity [%]	Electrode diameter [mm]
Cathode	20	39	32.6	14
Anode	10	35	30	15
	Separator thickness [μm]	Porosity [%]	Separator diameter [mm]	
Separator	25	55	16.5	

Target : 4 <Ratio< 5

	Volume [μL]
Total porosity [μL]	5.219
Advised electrolyte volume to add (=4.0 times total porosity)	20.88
Actual added amount	20.9
Ratio - Used electrolyte / Total porosity	4.005
<b>Comment</b>	Target met - Suitable electrolyte amount

	Volume [μL]
Total porosity [μL]	5.219
Advised electrolyte volume to add (=4.0 times total porosity)	20.88
Actual added amount	20
Ratio - Used electrolyte / Total porosity	3.832
<b>Comment</b>	Target not met - Please add more electrolyte

# Lever 4 - ASSEMBLY CHOICE

WUT

**BASF**  
We create chemistry

**KIT**  
Karlsruher Institut für Technologie

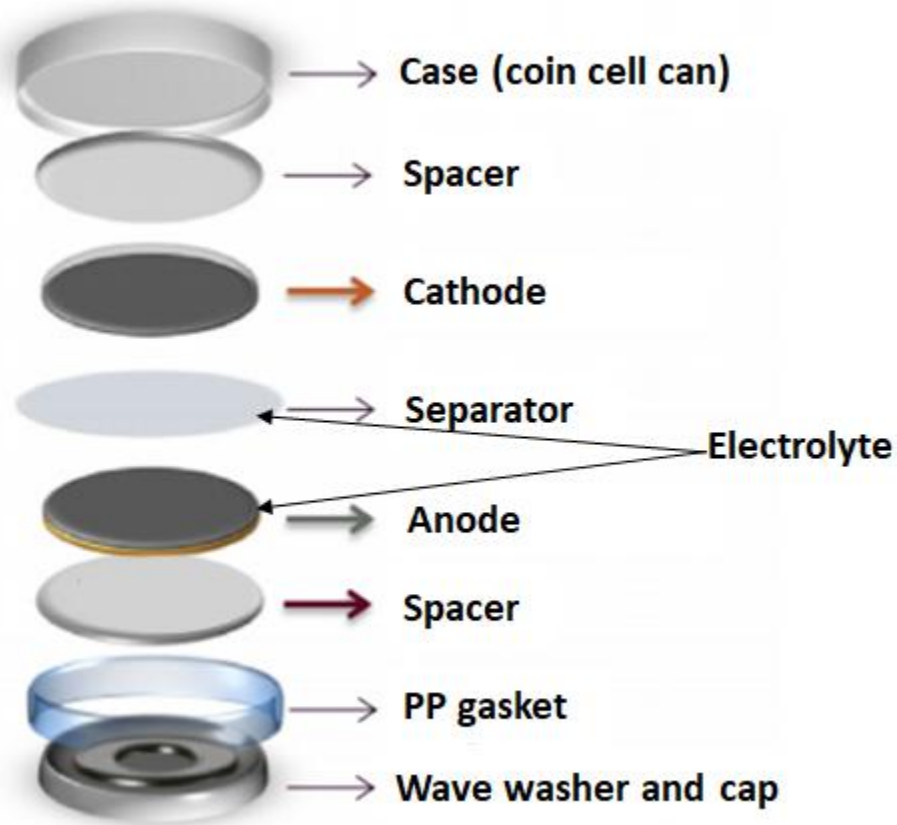
**cea**

**cidetec**  
energy storage

**Fraunhofer**  
ISC

**northvolt**

**JÜLICH** HELMHOLTZ-INSTITUTE  
Forschungszentrum MÜNSTER

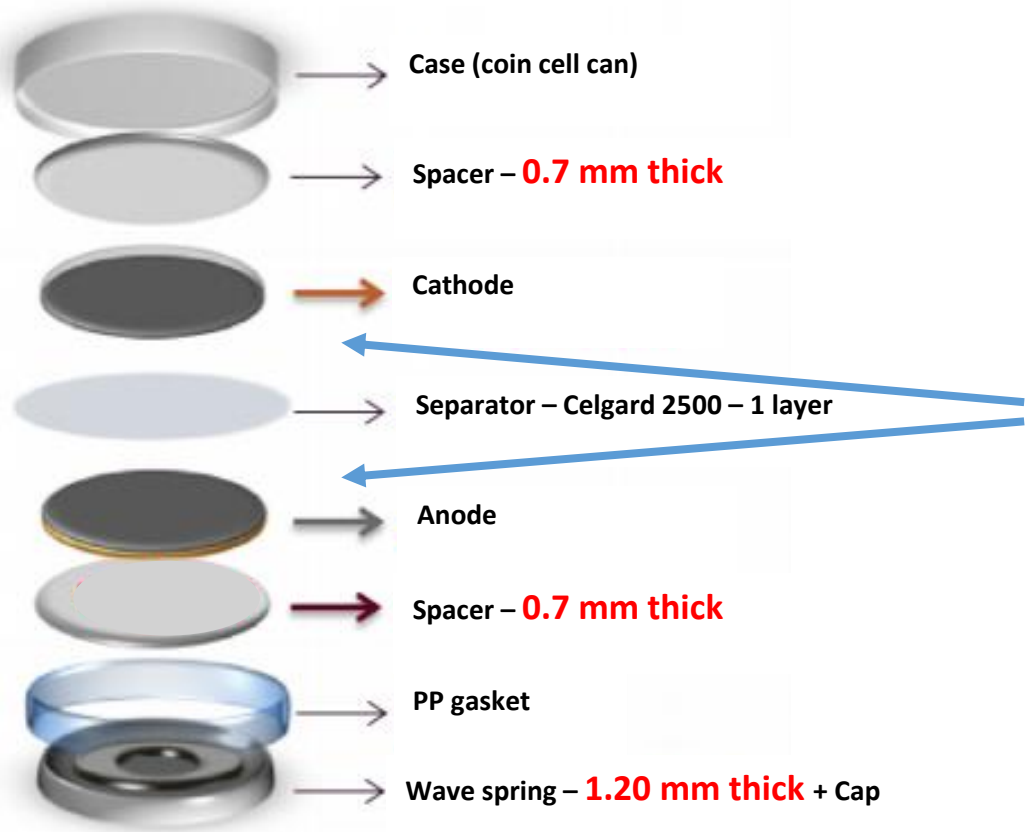


- Electrolyte amount: **21 – 100  $\mu\text{L}$**
- Electrolyte dispersion: single/double
- Assembly: anode  $\rightarrow$  cathode, cathode  $\rightarrow$  anode

8 different assembly tested

*Journal of The Electrochemical Society, 166 (2) A329-A333 (2019)*

# Lever 4 - ASSEMBLY



Electrolyte distributed on both sides of the separator

Anode below = Easier to align electrodes

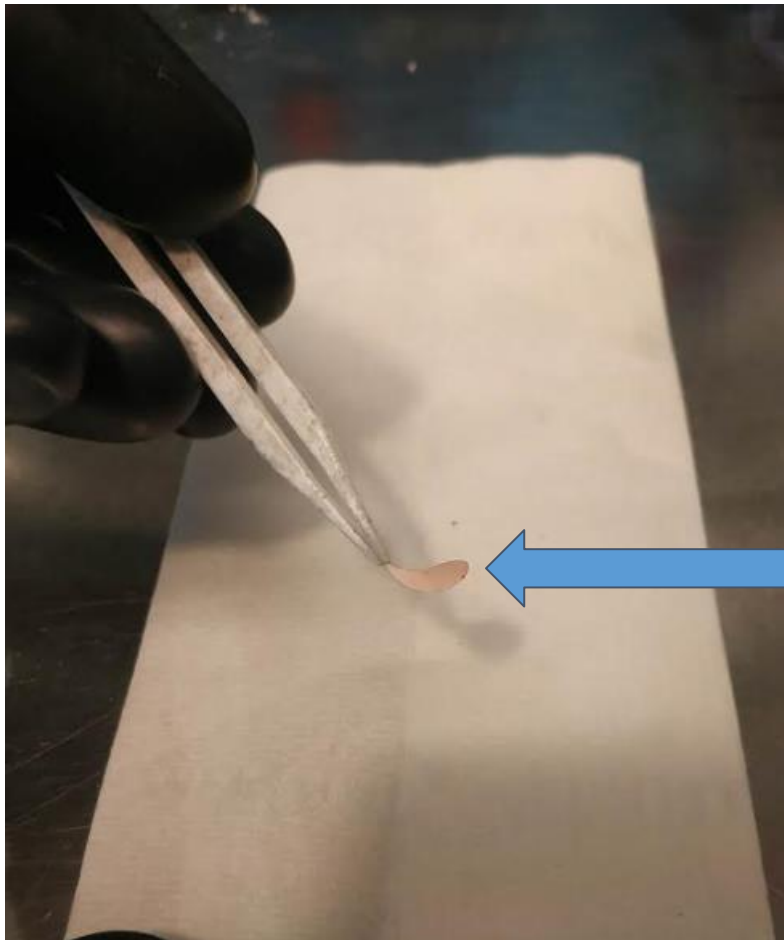
## BIG-MAP standards

15 mm diam. anodes  
14 mm diam. Cathodes

Electrolyte volume = 4.0 times total porosity

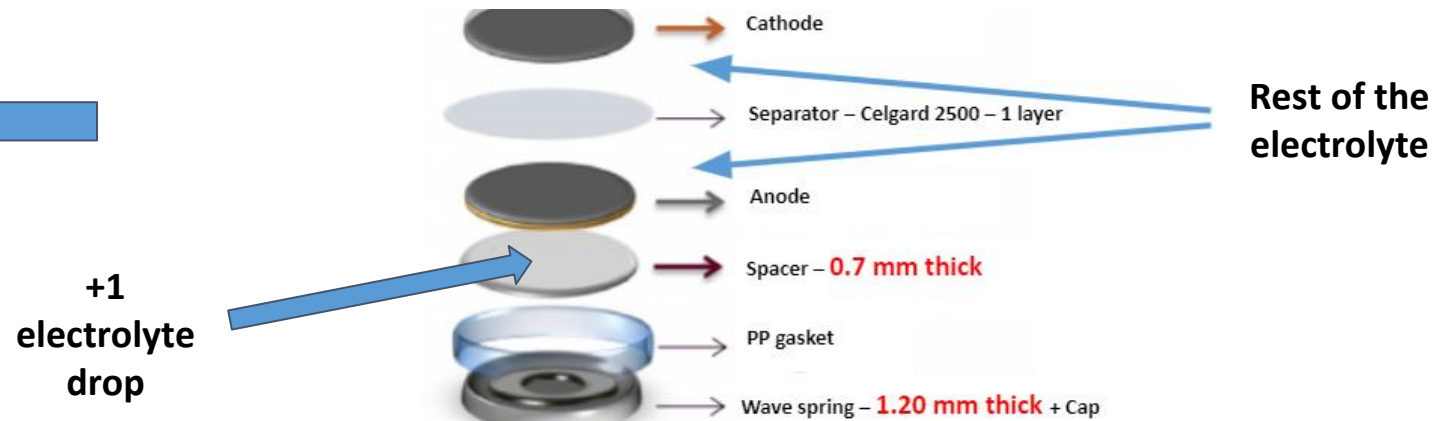
Crimping : 800 kg

# Lever 4 - TIPS FOR ASSEMBLY



## If curved electrode

- Drying under weight
- Add a drop between spacer en the electrode → Wettability effect
- Homemade electrode, use thicker current collector

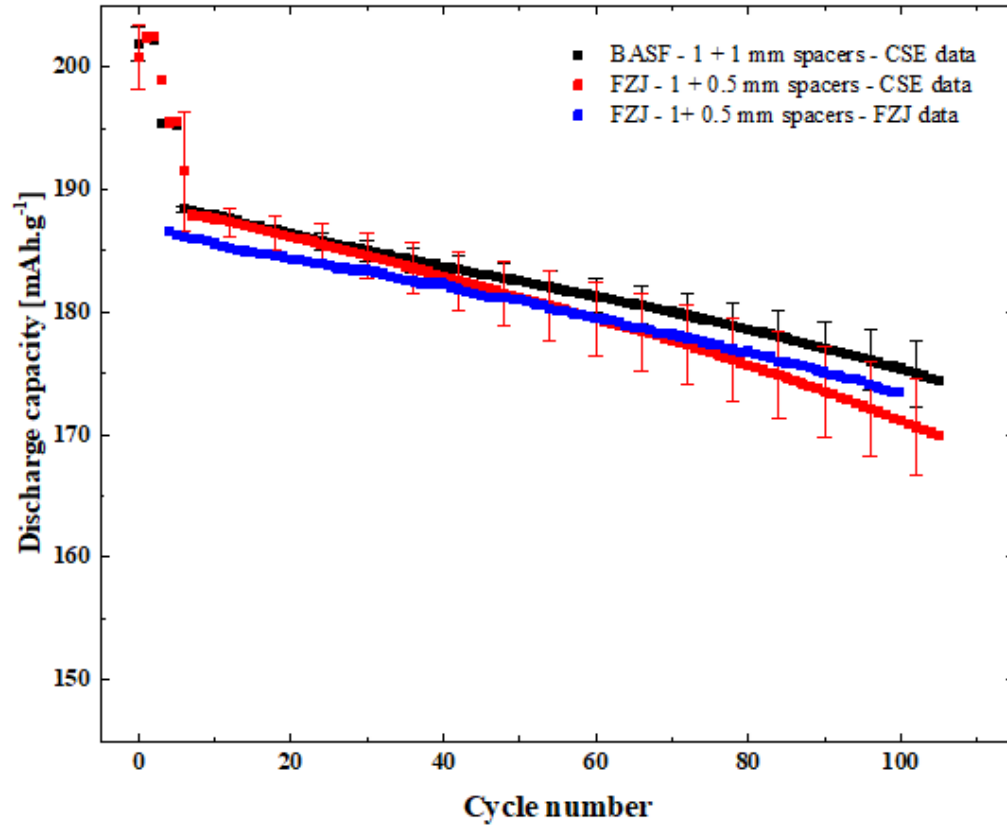


If curved Celgard, drying under weight

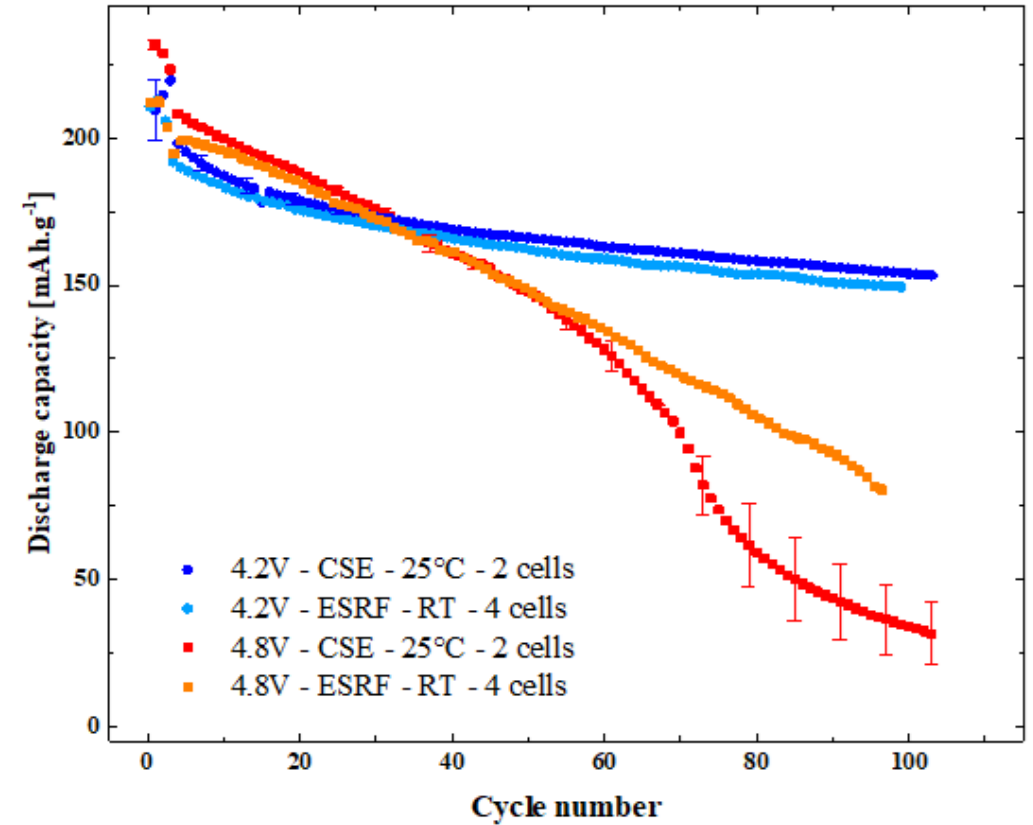


# REPRODUCIBILITY

NMC811 – Graphite – 4.2V – 1C



LiNiO<sub>2</sub> – Graphite – 1C



# THANK YOU