



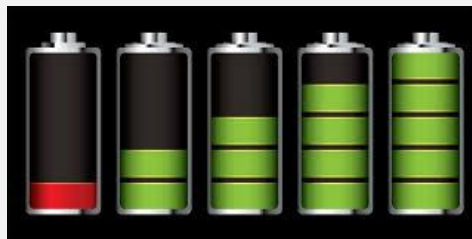
Lithium Ion Battery Cell Production

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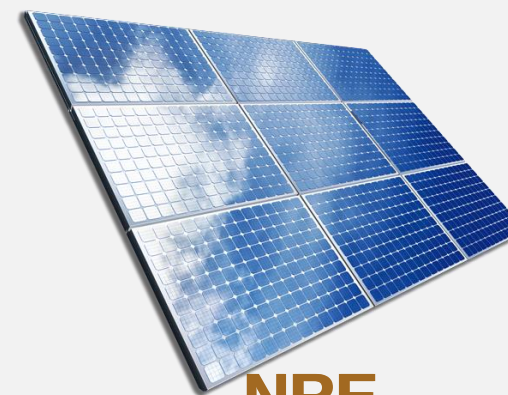
Gadgets



Power tools

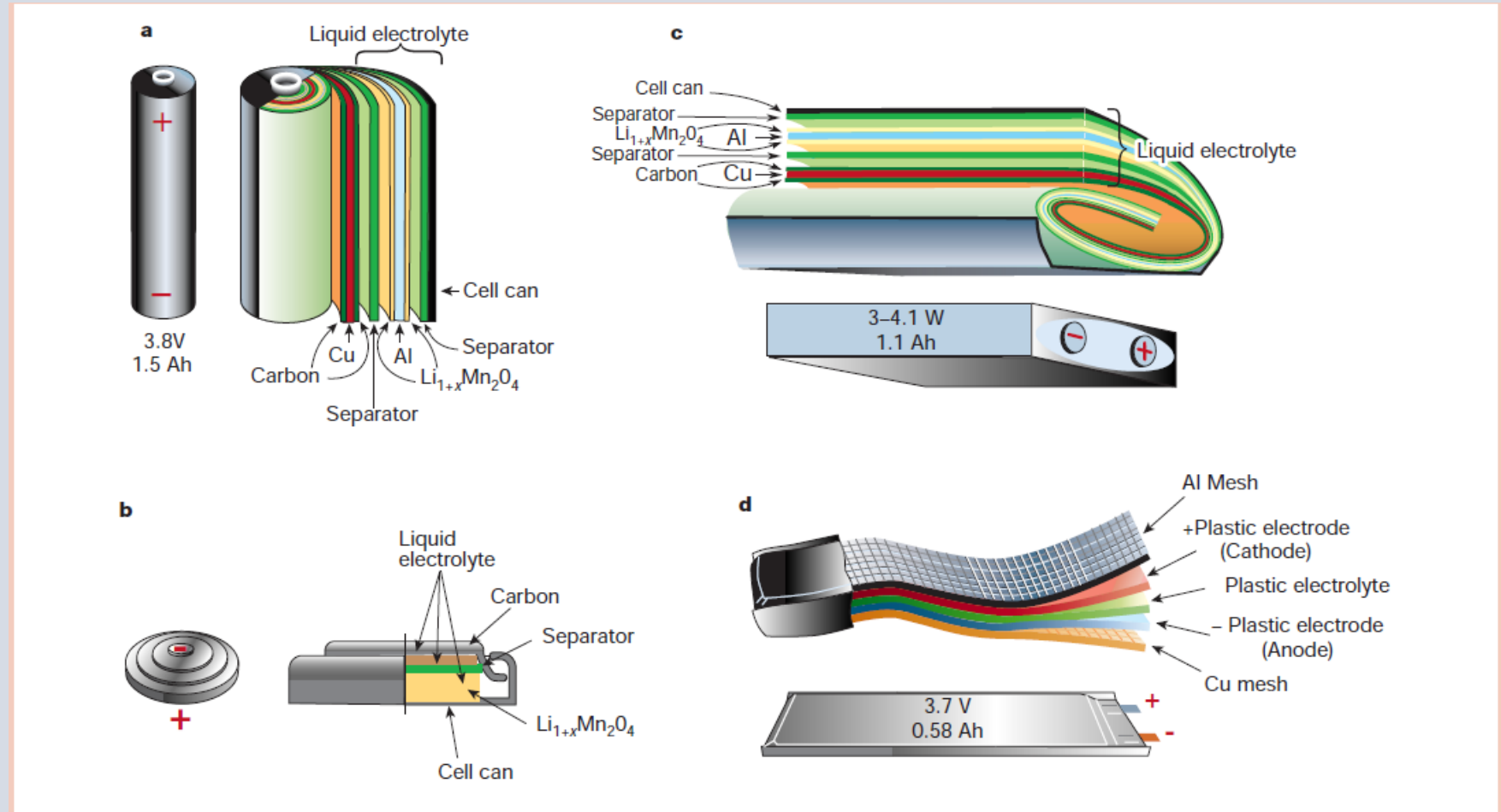


EV



NRE

Li-ion Cells : Shapes and Sizes



a. Cylindrical Cell

c. Prismatic Cell

b. Coin Cell

d. Pouch Cell

Brief Techniques of Assembly Process

Material Preparations



Slurry Making



Electrode Fabrication



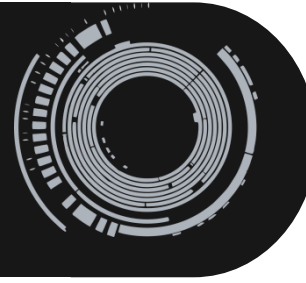
Cell Assembly



Cell Testing



Material Preparations



Active Materials

- Anode Materials
- Cathode Materials



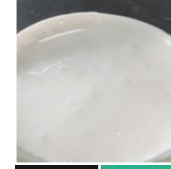
Conductive Agents

- AB
- KS-6
- Graphene
- CNT
- Hard Carbon



Binders & Thickening Agents

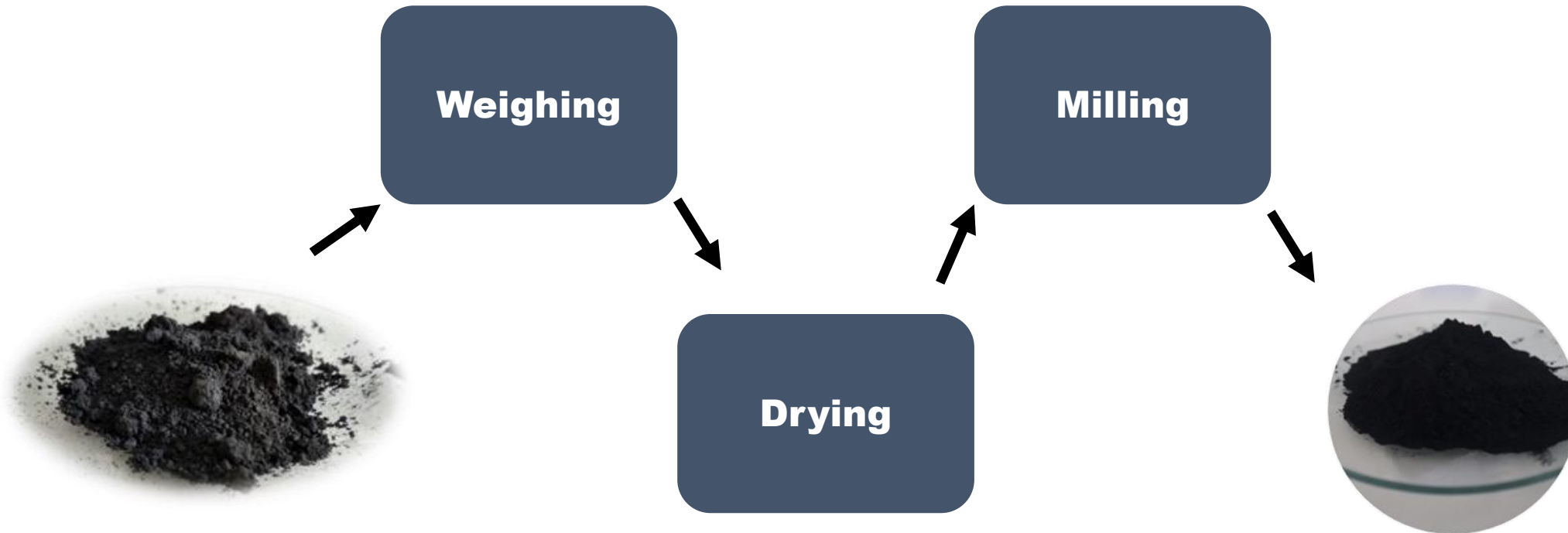
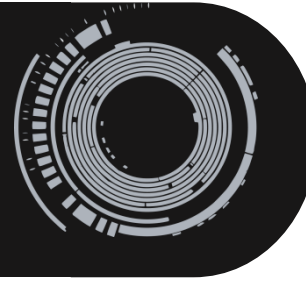
- PVDF
- SBR
- CMC
- Xantham Gum
- Etc.



Solvents

- NMP
- Deionized Water

Material Preparations



Slurry Making

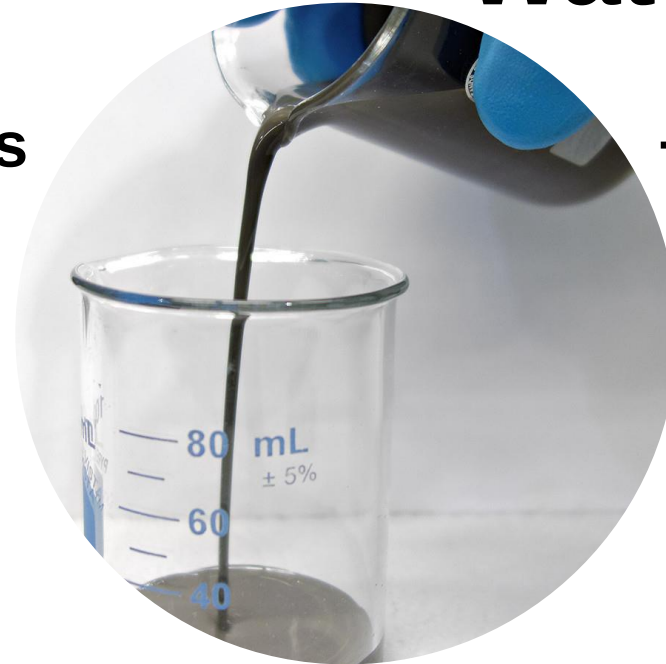


NMP Based



- + Unreactive towards cathode
- + Good solubility
- + Consistency
- + Good Adhesion

Water-Based



- + Cost saving
- + Energy Saving
- + Environmental Friendliness
- + No Solvent recovery

Slurry Making



NMP based Binders

PVDF

PTFE

PAA

Water-based Binders

CMC

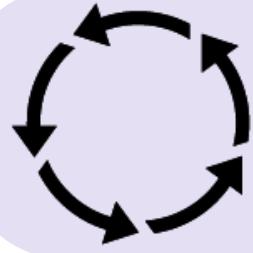
SBR

Na-CMC

Xanthan Gum

Gelatine

Natural Rubber



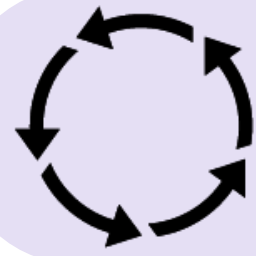
Electrode Fabrication

1 Doctor Blade

2 Intermitten-Continuous Coater

3 Spray Coating

4 Solvent-Free (Dry) Coating



Electrode Fabrication

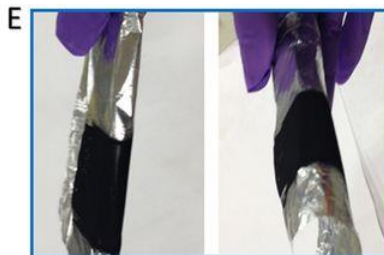
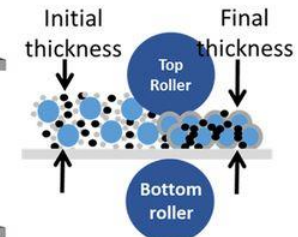
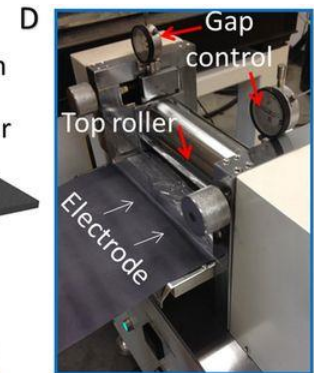
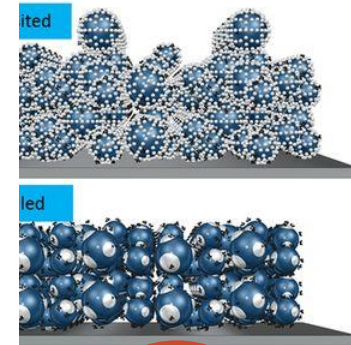
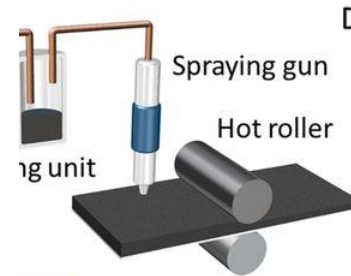
2

Intermittent/Continuous Coater



1

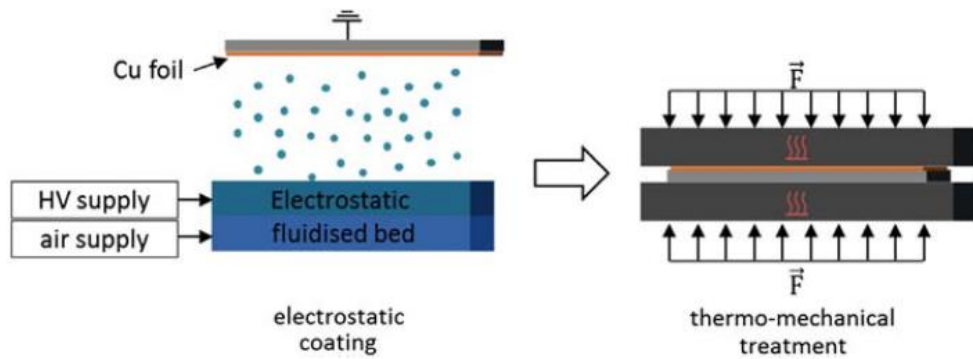
Doctor Blade



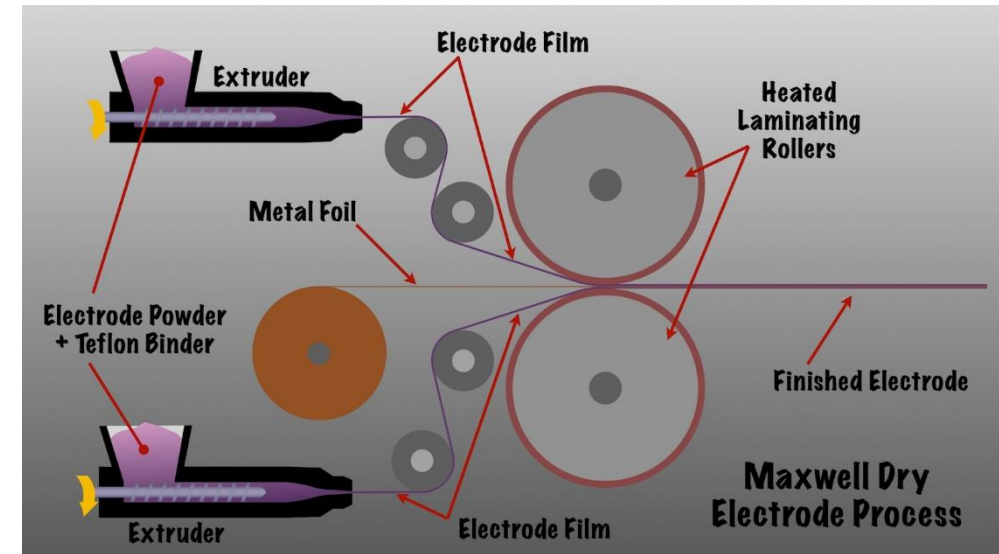
3

Spray Coating

4 Solvent-Free (Dry) Coating



Electrostatic coater

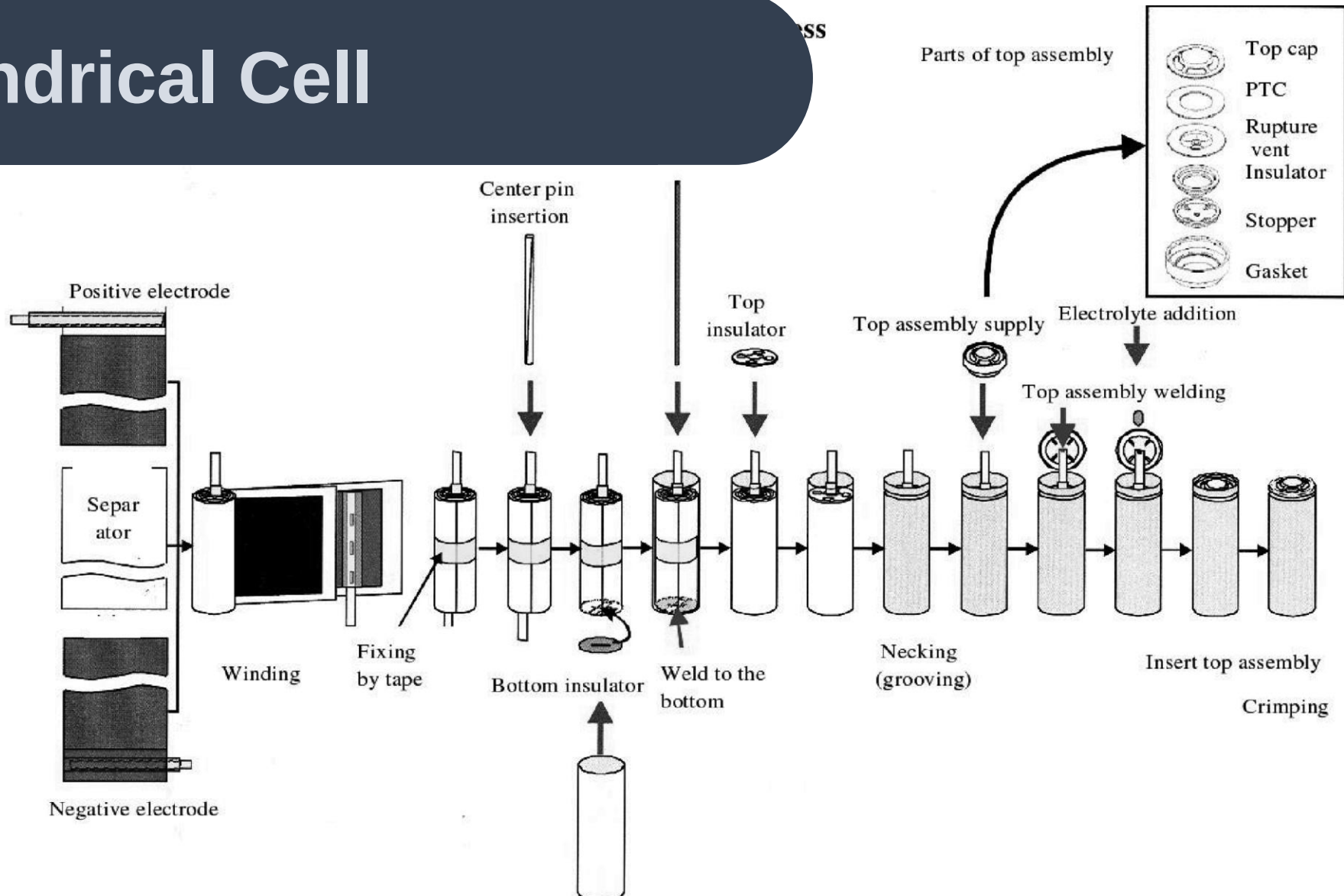


Maxwell's coater

Cell Assembly

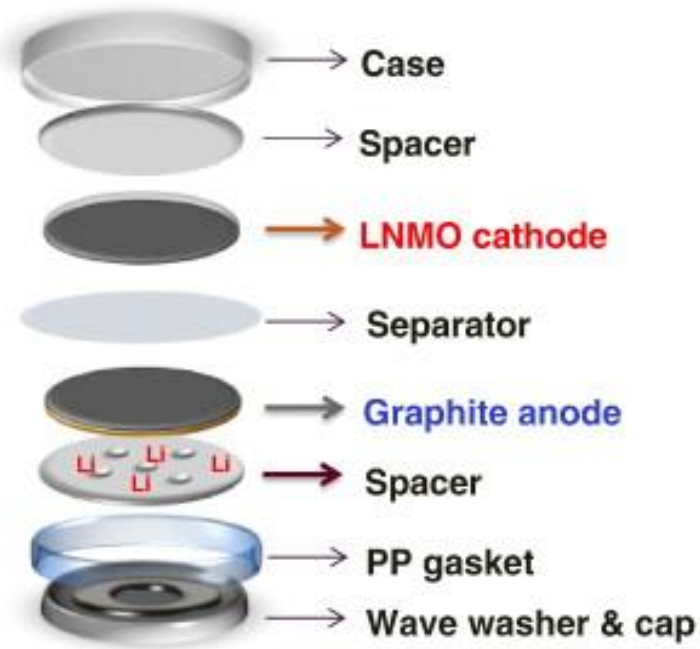


Cylindrical Cell

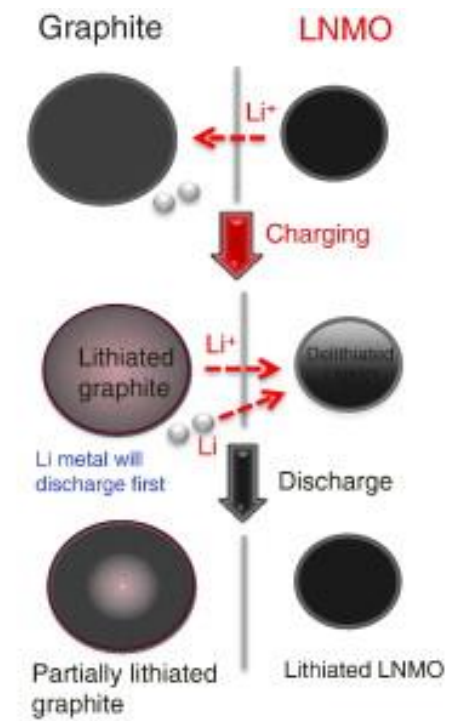


Cell Assembly

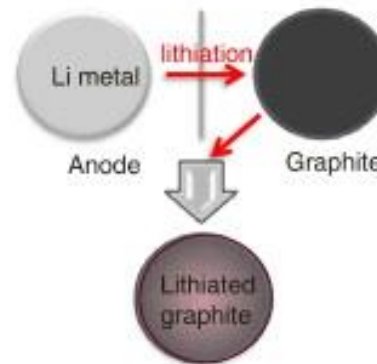
Coin Cell



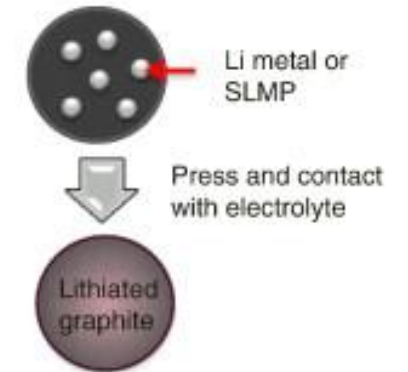
(a)



(b)



(c)

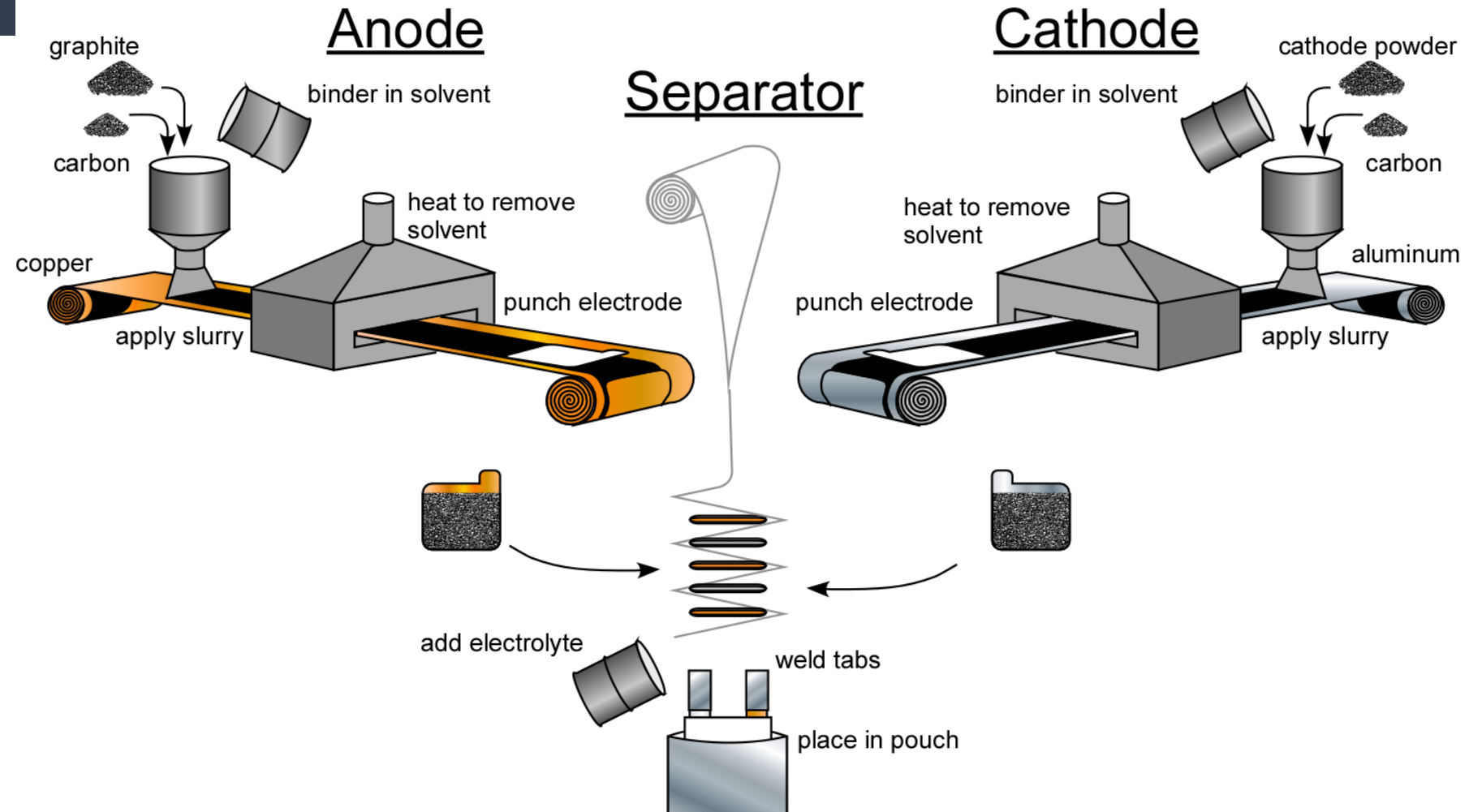


(d)

Cell Assembly



Prismatic/Pouch Cell



Cell Assembly

Current Technology: LASER

Foil slitting: during the foil slitting step a wide roll of battery foil is cut along the length of the roll into narrow strips as required by the cell design. An infrared pulsed laser works well for foil slitting. It can cut through coated metal foil electrodes at a high speed with good quality. If a narrower cut width or higher quality is desired, a pulsed green or ultraviolet (UV) laser can also be used for foil slitting.

Foil cutting: during this step anode and cathode foil strips are cut to a desired pattern as required by the cell design. Depending on the cell design and whether the entire width of the foil roll is coated or not, during this step the laser needs to cut through coated foils or just the metal foil. Lasers used for foil slitting also work well for this process.

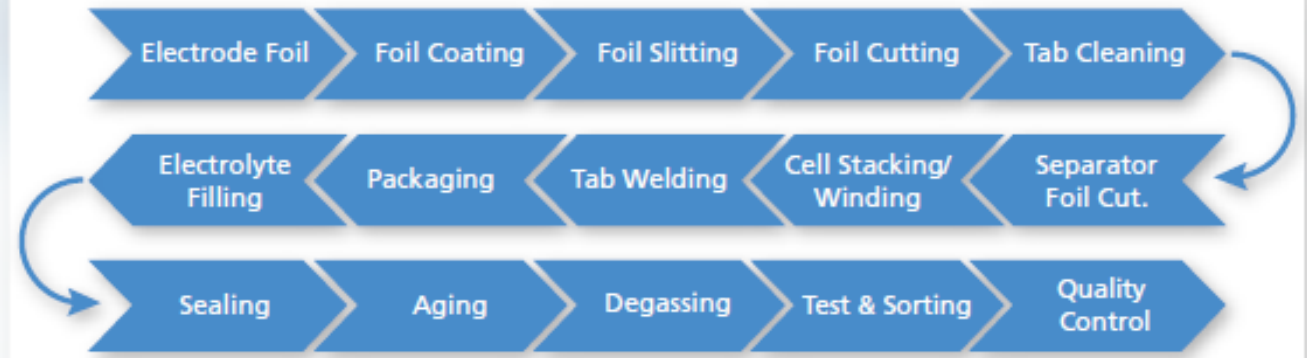


Figure 2. Schematic of steps involved in roll-to-cell Li-ion battery cell manufacturing process.

Tab cleaning: depending on the battery foil structure and cell design, in some cases removal of graphite and lithium-metal-oxide is necessary to expose bare copper and aluminum foil tabs. The key during this process step is to remove the coating material without harming the metal foil underneath. Pulsed IR lasers seem to work well for this step and provide the needed selectivity in removing coating without harming the metal foil.

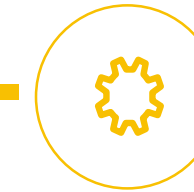
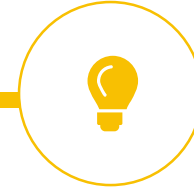
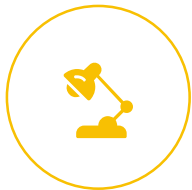
Separator foil cutting: similar to foil cutting, separator foil are also cut to a desired pattern as required by the cell design. Since separator foils are made of organic material a pulsed UV laser is best suited for this process step.

Cell Testing



Safety Test
*Over-charge, over
discharge, Nail test,
short test*

Visual Test
Cell Checking



Electricity Test
*rate, lifecycle, storage,
Impedance, OCV*

**Mechanical and Environment
Test**
*Vibrasi, drop test, crush test,
impact test, shock test*

Standard Environment Test