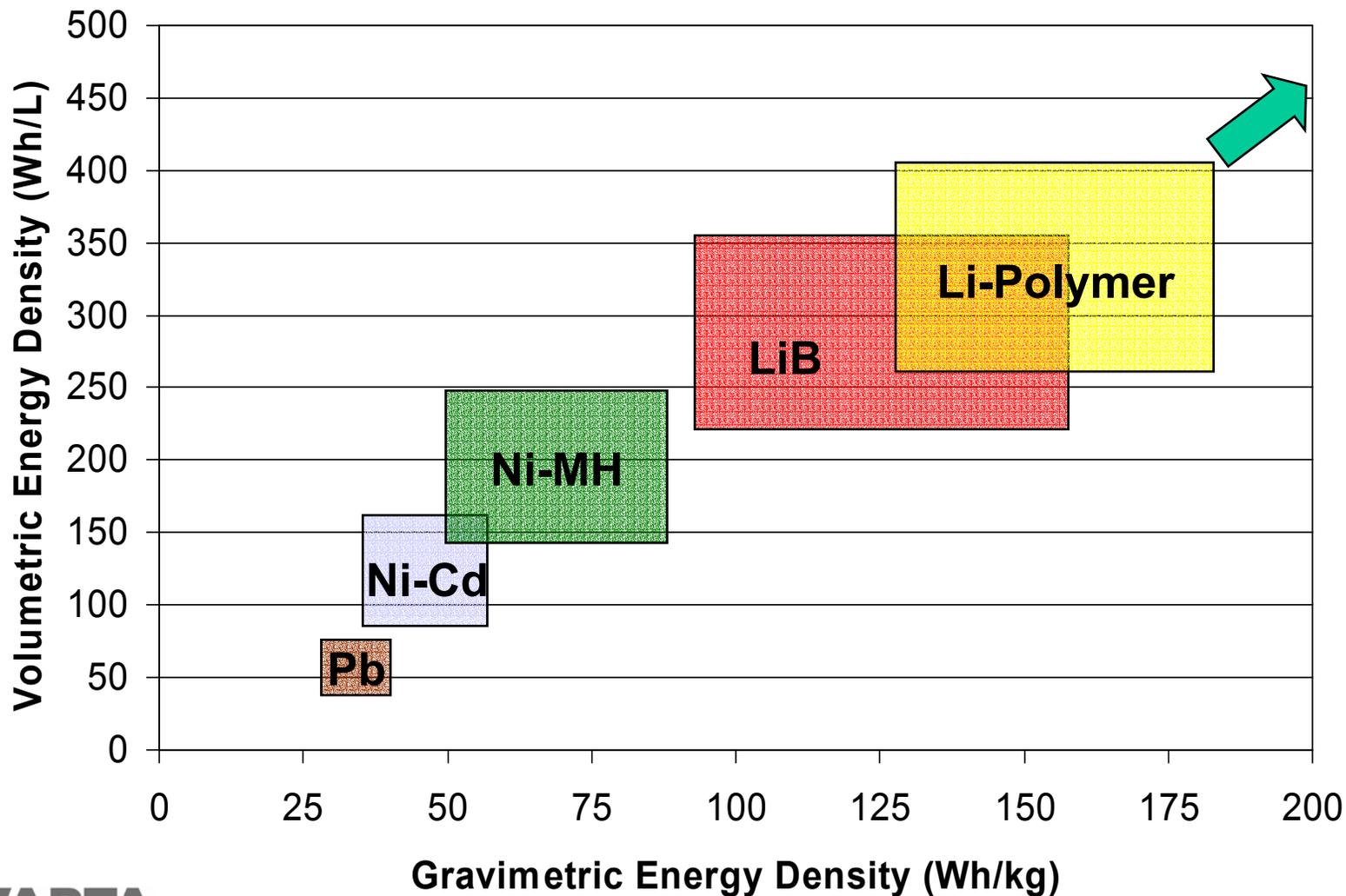


The Technology

Energy Density Comparison



Li Battery Technologies

Li-Ion

- Free Electrolyte (visible, ability to leak out)
- Solid Steel or Aluminium Housing (recently tests with aluminium foil), more weight, danger through overpressure



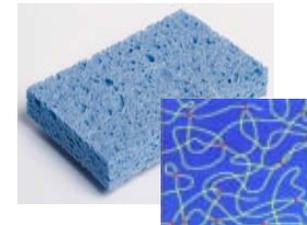
Li-Ion-Gel-Polymer

- Gel-Electrolyte (visible, not bound, lubricates)
- Aluminium Foil (low weight, gel-electrolyte may leak out)

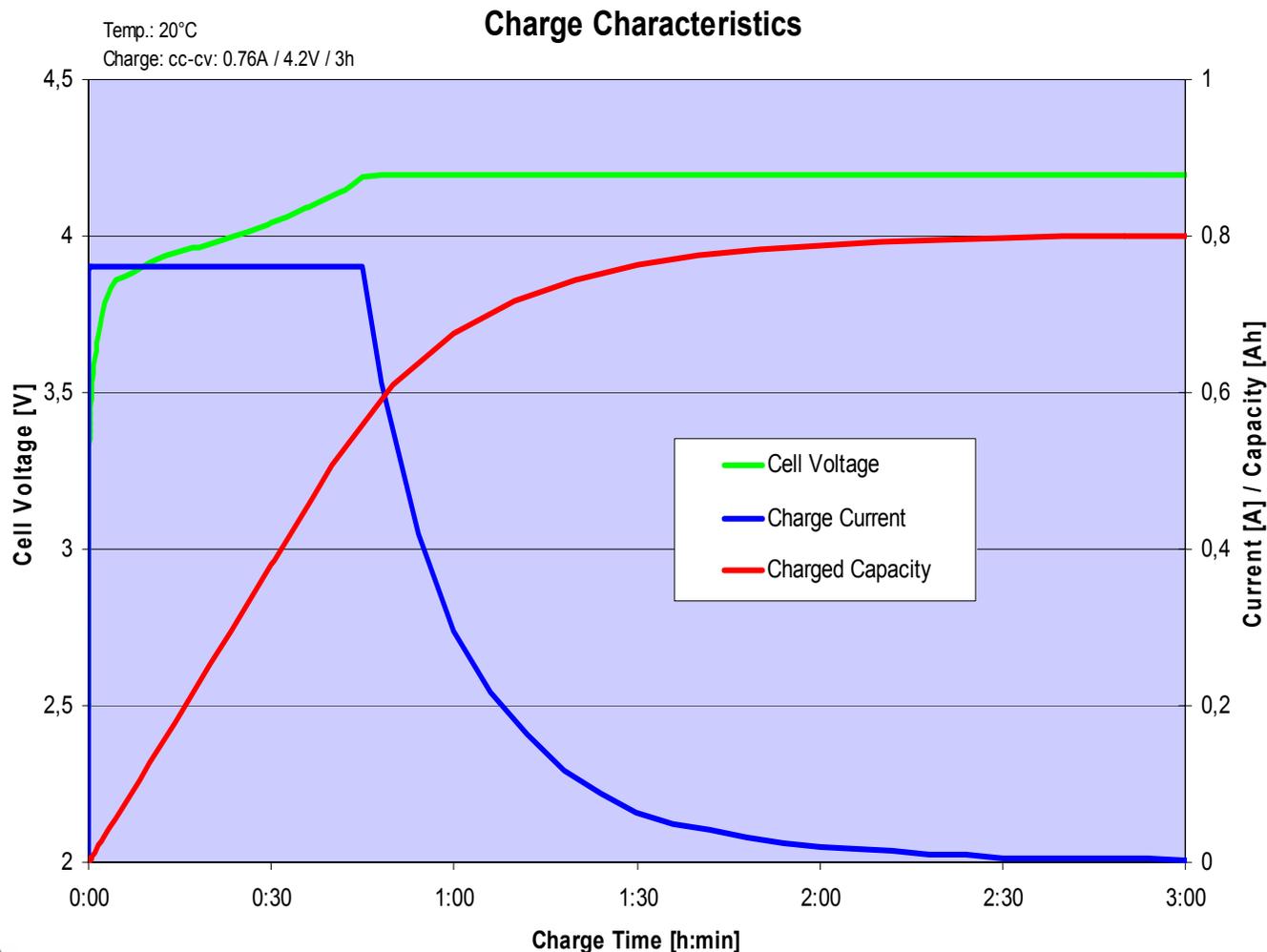


Lithium-Polymer

- In Polymer-Matrix bound Electrolyte (not visible, bound, dry)
- Aluminium Foil (low weight, lower pressure, no electrolyte can leak out)



PLF 423566 Charge Characteristics



Electrochemistry / Construction

Anode

C - based embedded in Polymer

Cathode

**LiMeO₂, LiMe₁Me₂O₂, (Me=Co, Ni)
embedded in Polymer.**

**Electrolyte/
Separator**

**Lithium salt with polymer integrated
in electrode and separator structure**

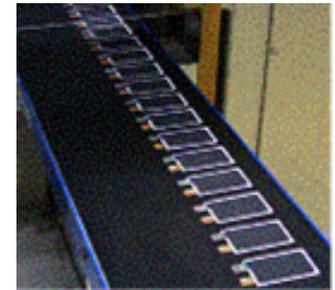
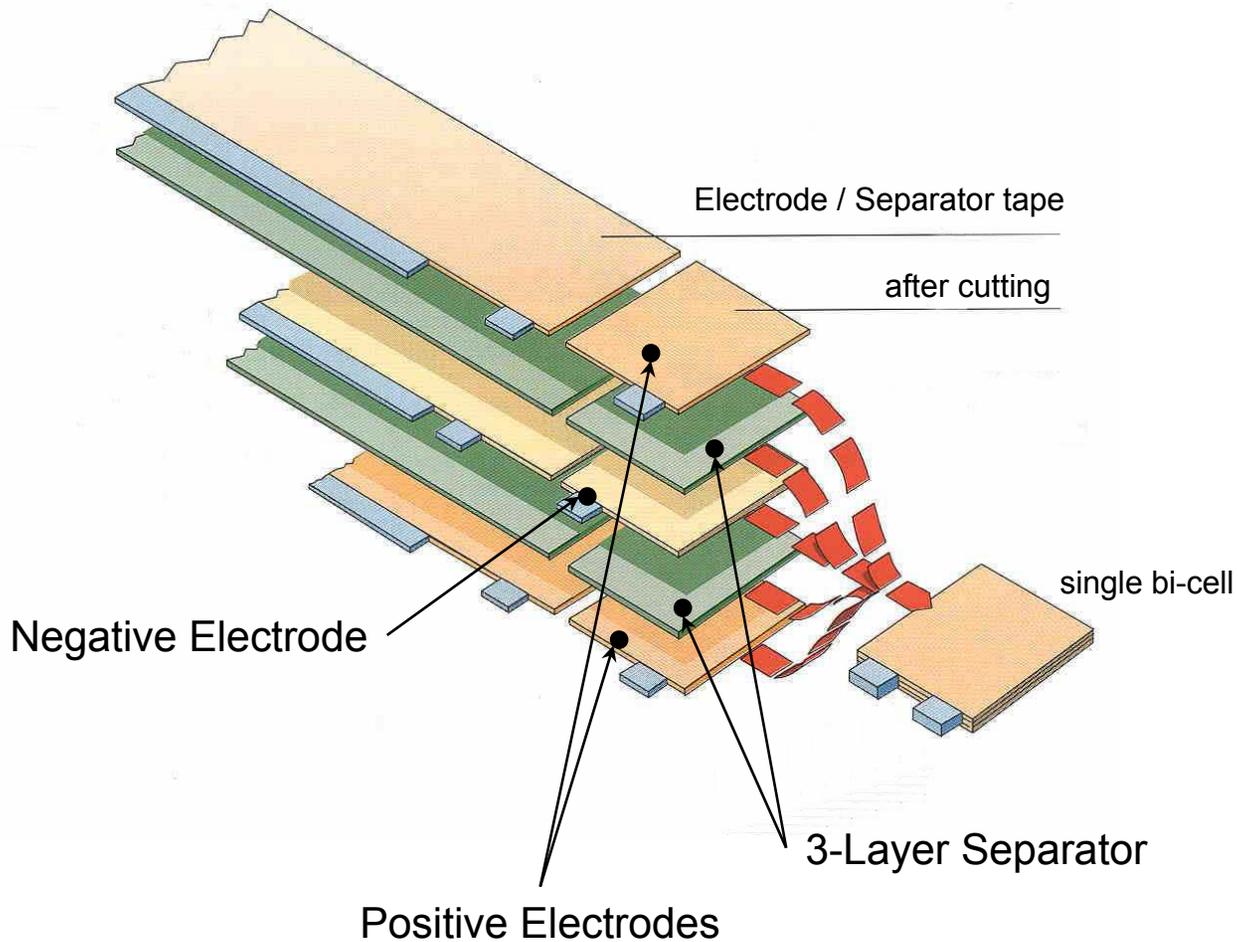
**Current/
collectors**

**Negative: Cu down to 10 µm.
Positive: Al grid-like down to 20 µm**

**Electronic/
elements**

**Different kinds of PCMs designed
for each special application**

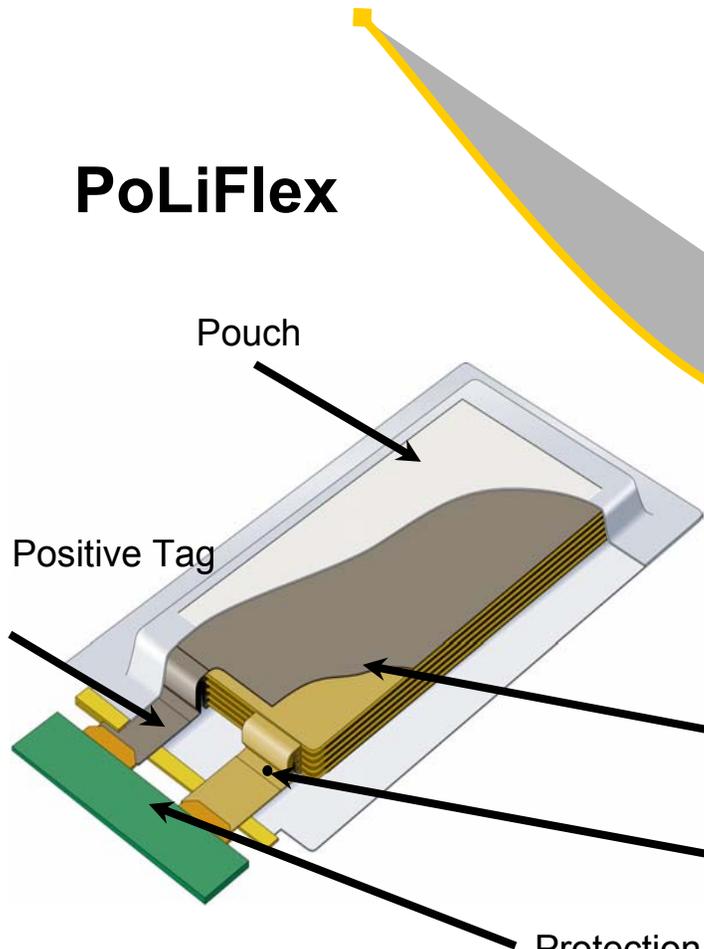
Innovation PoLiFlex Laminated Stack Technology



Lithium-Polymer PoLiFlex®

Coil Type Polymer

PoLiFlex

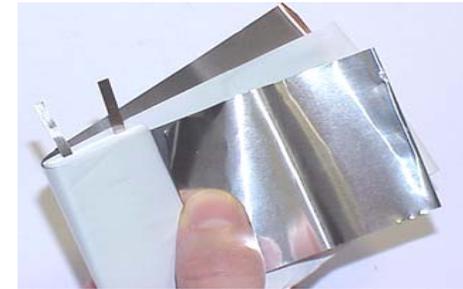
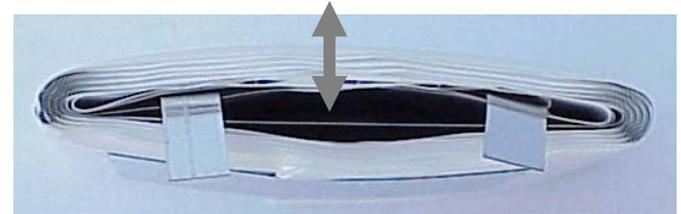


Pouch

Positive Tag

- Bi-Cell Stack:
- excellent durable contact
 - large surface
 - excellent high rate performance
- Negative Tag

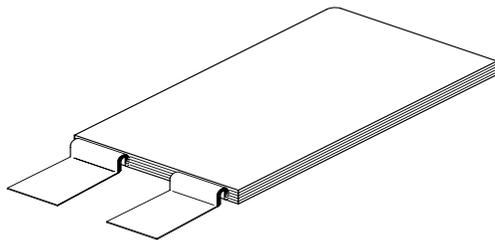
Protection Circuit Module PCM



Key Differences in Polymer Technologies

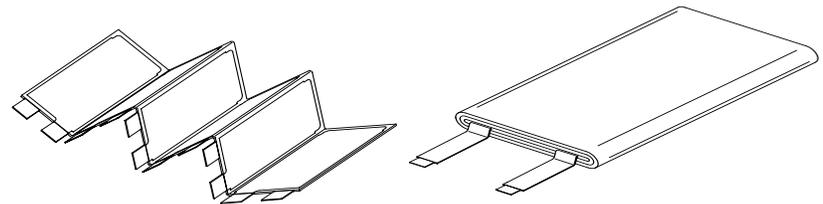
PoLiFlex :

- Polymer based electrode
- Electrolyte fixed in a polymer matrix, thus NO free electrolyte
- Electrodes and separator laminated, thus solid contacts, independent from pressure or temperature.



'Classic' Polymer / Li-Ion pouches:

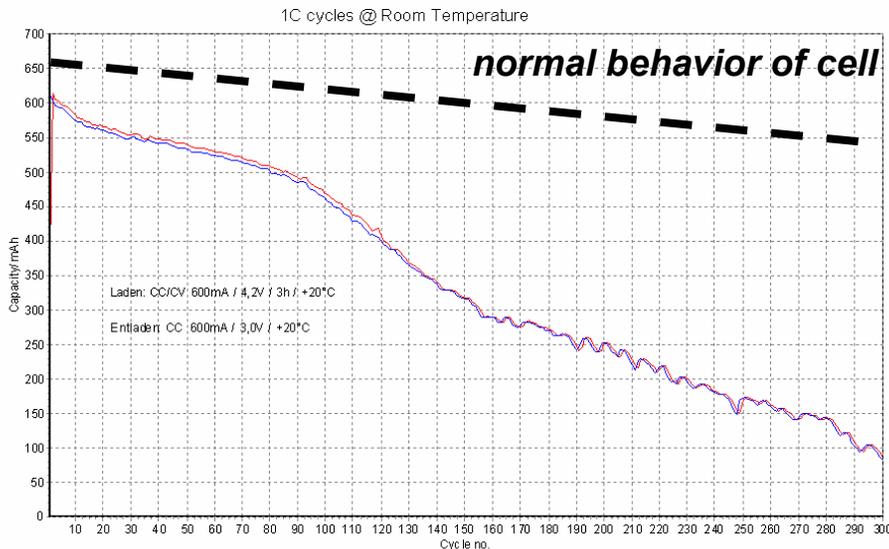
- Pasted gel electrodes
- Free or partly free electrolyte
- Electrodes and separators coiled or folded, no solid contact. Pressure and temperature influenced conductivity.



Key Benefits of PoLiFlex Technology:

- The lamination technology guaranties a stable and solid contact between the electrodes over the complete lifetime within a wide temperature range. It is the cell design itself that absolutely minimizes the potential of a sudden battery failures caused by contact problems or increased Ri.

The PoLiFlex Technology is predestinated for design where highest reliability and / or high capacity retention is preferable.



*Risk with folded,coiled cells
 Error behavior caused by contact problem.
 Sudden capacity drop – higher Ri.
 In real applications: customer complains*

Why to use VARTA PoliFlex → Benefits of PoliFlex

Li-Ion prismatic hardcasing

- more weight at similar capacity
- thickness mostly > 5 mm
- mostly high swelling > 1mm non reversible
- liquid electrolyte: may leak and destroy electronic
- safety circuit needs additional space
- electrodes coiled: no solid contacts

VARTA PoLiFlex®

- 15-30% less weight (i.e. comp. to steel can)
- slim: down to 2 mm
- low swelling (0,2 mm)
- no free liquid electrolyte, no risc of damage the electronic
- safety circuit needs **no additional** space (incorporated in sealing area)
- lamination technology: -solid contact
-high reliability