Cell Frame Bonding

ADVANCED MANUFACTURING PROCESSES FOR LOW COST GREENER LI-ION BATTERIES

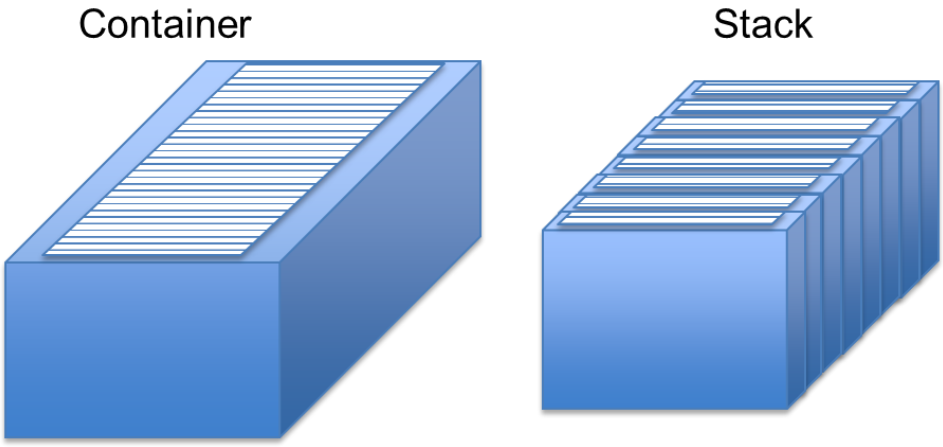
Introduction

Li Ion cells are one of the most popular types of rechargeable batteries for portable electronics, with a high energy density, small memory effect,[8] and only a slow loss of charge when not in use. Beyond consumer electronics, they are of increasing use in military, battery electric vehicle and aerospace applications.

There are various design strategy of the moduls, depending on the targeted power density, active materials and targeted use. One important point to focus on in the development of a new module design is the way cells will be assembled.
This paper proposes a quick overview of bonding solutions to assemble cells in the module.

2 main module designs

There are 2 main solutions for the assembly of cells, as indicated below.



In both cases, bonding material can be used, for different reasons or functions :

- Positioning (T sensor)
- Sealing (encapsulation)
- Mechanical reinforcement

Bonding solution vs module design

1. Container

In this configuration, adhesives may be used for :

- Encapsulation of the cells in the container (potting)
- Bonding of thermocouples and sensors on cells and container

The table hereunder gives an overview of the different bonding solutions available for this design.

Use	Type	Processing	Cost	Prioritary Functions
Potting	2 component epoxy (rigid). Foamable versions available	Room temperature cure (full cure in 1 to 7days). 70% of full strength in 8hrs. Accelerated cure schedule in T	Moderate (30-50€/kg)	• Sealing • Mechanical performance (level TBD) • Thermal conductivity (level TBD)
	2 component polyurethane (semi-rigid to rigid)	Quick room temperature cure	Moderate (20 to 40€/kg)	
	2 component silicone (flexible)	Same as for epoxies	High (40 to 80€/kg)	
Bonding of sensors	Hot melt (PSA or Reactive Polyurethane)	Hot dispensing (caution on cell T)	Low (10 to 30€/kg)	• Permanent contact between sensor and cell • Thermal conductivity (level TBD)
	Tape	Laminated	Depends on performances	

The next table give additional info on the different adhesives listed above.

Properties	Epoxies	Silicones	Urethanes
Temperature °C	-65 to +180	-55 to + 200	-55 to +125
Hardness	Rigid	Soft	Soft
Flexibility	Low	High	High
Tg (°C)	0 to 160	-65, flexible above	-65 to 80
Cure temperature	Room/Heat cure	RT/ Dual cure	Room Temperature
Cure method & time	Heat cure; 1 to 3 hours	UV cure; 30 to 60 secs	Room & Heat cure; 1 to 3 hours
Thermal shock	Good	Best	Very Good

2. Stack

In this configuration, adhesives may be used for :

- Encapsulation of the cells in the stack units
- Bonding of units to each other (instead of screwing or combined with screwing)

The table hereunder gives an overview of the different bonding solutions available for this design.

Use	Type	Processing	Cost	Prioritary Functions
Potting	Same as for container design			
Bonding of stack units	2 component (epoxy or polyurethane)	Room temperature cure (accelerated in T)	Low to moderate	• Mechanical performance depends on the module design and expected role of the adhesive (structural, positioning, thermal contact) • Thermal conductivity (level TBD)
	Tape	Laminated	Depends on performances	

Contacts

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