

## Partnering for *greener energy*

With industry partners, we develop polymers for more efficient batteries with higher energy density.

### BATTERY APPLICATIONS

#### ELECTROLYTE

Specialty polymer as solid-state electrolyte

#### CATHODE

Binder/additives for cathode

Dispersant in carbon black/CNT

#### ANODE

Binder for Si-anode  
Phenolic resin as precursor/additives for anode

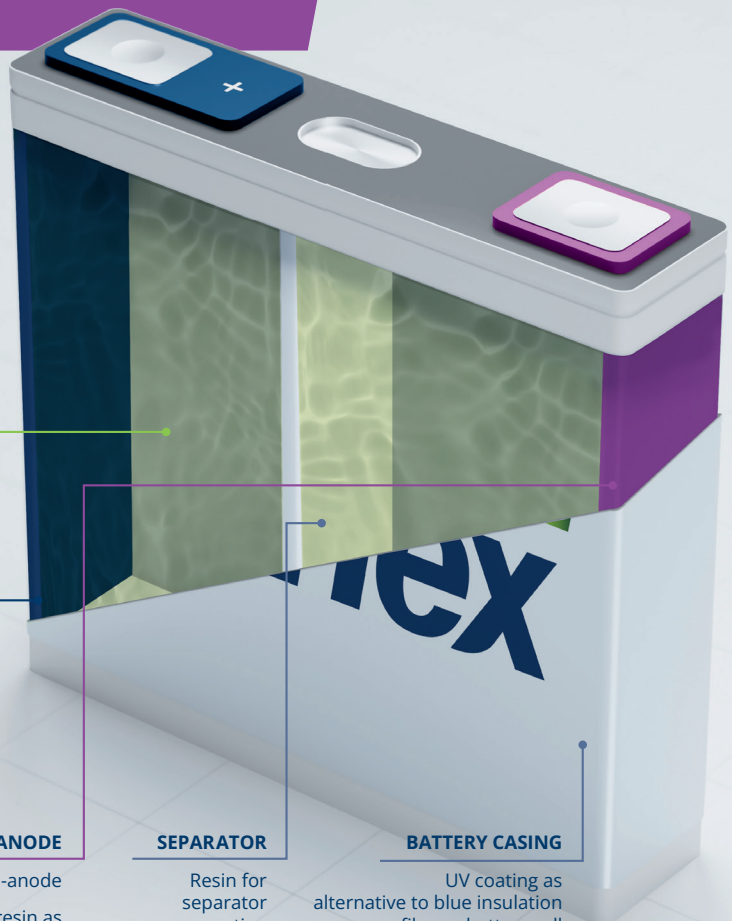
#### SEPARATOR

Resin for separator coating

#### BATTERY CASING


UV coating as alternative to blue insulation film on battery cell

Resin for adhesives and coatings for battery pack



## What's already there – existing solutions for lithium-ion batteries (LIBs)

In addition to newly developed solutions, allnex offers a wide variety of existing products suitable for enhancing the manufacture and performance of LIBs:



UV/EB-curable acrylate oligomers and monomers from our **EBECRYL®** range

Thermal plastic phenolic resins from our **ALVONOL®** range

Dispersants from our **ADDITOL®** range

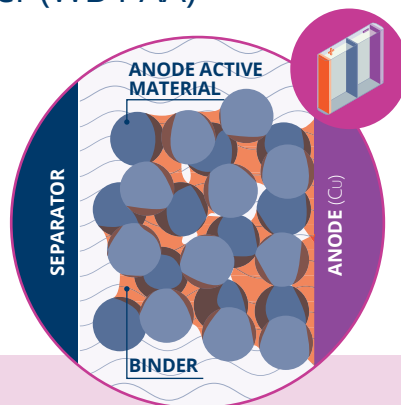
Amino resin crosslinkers from our **CYMEL®** and **SETAMINE®** ranges

**allnex**

## Innovation example – Anode binder (WB PAA)

### Performance characteristics

- High molecular weight, strong bonding force
- Strong resistance to electrolyte
- Excellent adhesion strength
- Excellent thermal stability and electrochemical stability
- Suitable for silicon-carbon anodes



In response to market requirements for higher-capacity lithium-ion batteries, allnex has developed a water-based binder that helps suppress Si-anode expansion over charge-discharge cycles.



### POUCH CELL TESTING

In pouch cell testing with a Si-anode, allnex's binder showed better cycling performance than other water-based binders in the market.

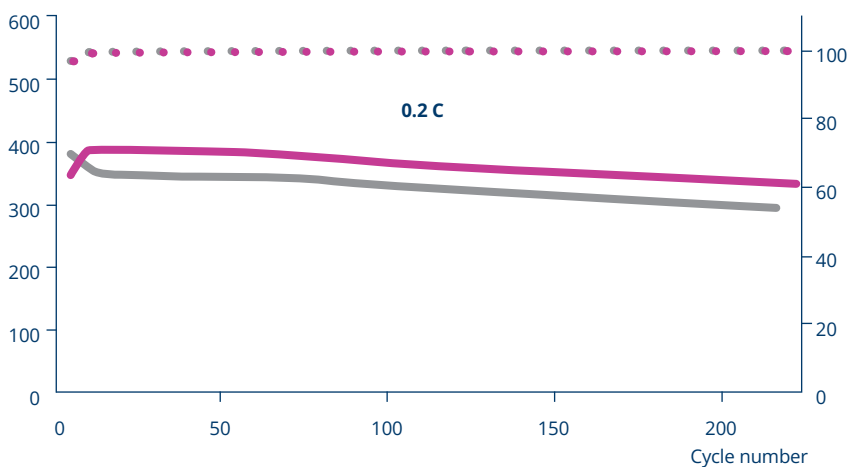
### TYPICAL PARAMETERS

Solvent	Water
Appearance	Translucent liquid
Solid content	5.0 %
Viscosity at 23 °C	1,500 mPa·s
pH at 25 °C	8.2

Specific capacity  
[mAh g<sup>-1</sup>]

● ● ● ● allnex binder  
● ● ● ● Control binder

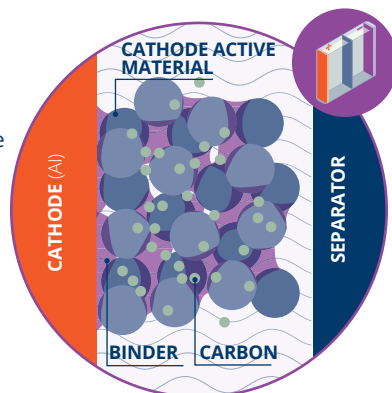
Coulombic efficiency  
[%]



# Innovation example – Cathode co-binder/additives

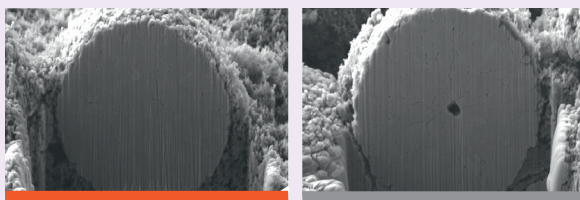
## Performance characteristics

- Less dissolution of transition metals (Ni/Co/Mn) in cathode and deposition on anode, preventing increase of internal impedance
- Inhibits decomposition of electrolyte on cathode surface
- Significantly improved capacity retention at high-voltage cycling in batteries using various cathode materials (NCM/LMNO)
- Reduces PVDF



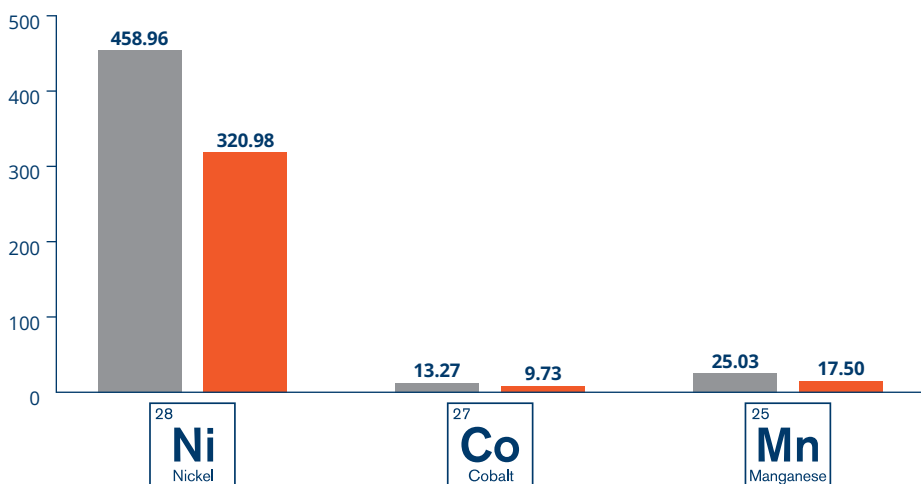
In response to the market demand for lithium-ion batteries with higher capacities, eco-friendly materials and faster charging rates, allnex has developed cathode binder/additive solutions that meet these needs.

## POUCH CELL TESTING



## Dissolution [ppm]

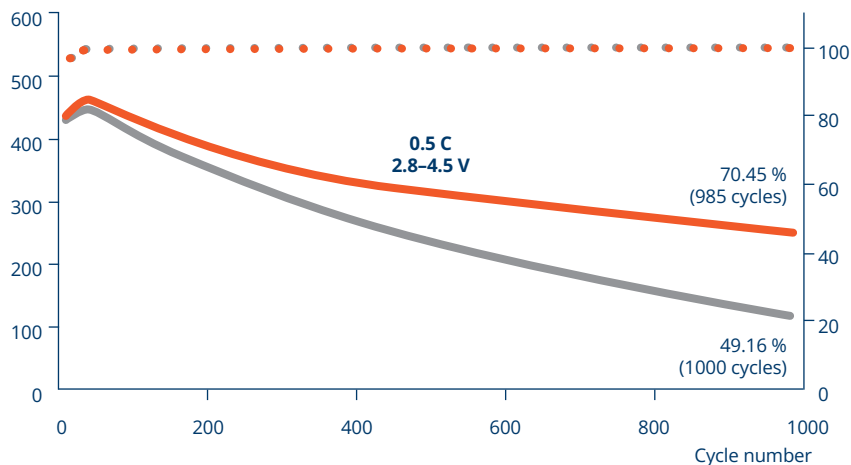
- With allnex's additive NCM811 – X611 (0.75 %)
- Pristine



**Discharge capacity**  
[mAh g<sup>-1</sup>]

EB X611  
Pristine

**Coulombic efficiency**  
[%]

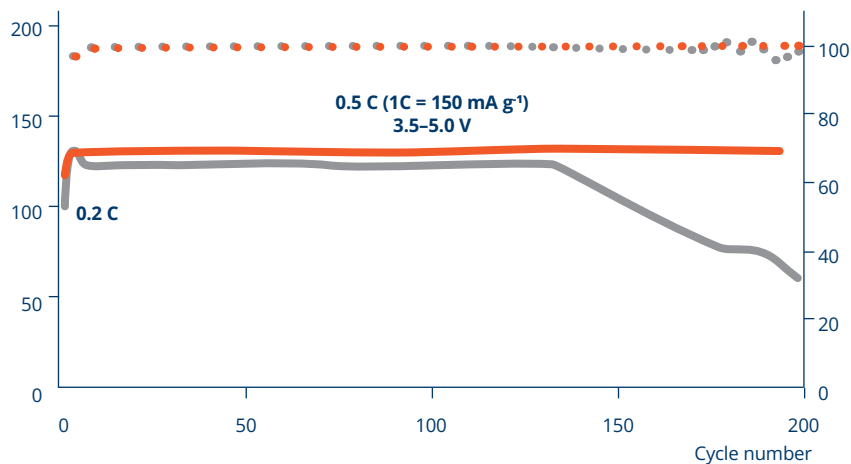


In pouch cell testing at 0.5 C in the voltage range of 2.8–4.5 V, using allnex's additive solution for cathodes resulted in better cycling performance than pure PVDF.

**Discharge capacity**  
[mAh g<sup>-1</sup>]

LNMO-PVDF/X611  
LNMO-PVDF

**Coulombic efficiency**  
[%]





## Enhancing e-mobility – Our solutions for better batteries

### UV/EB-curable coatings

- Usually consist of epoxy acrylate oligomer/urethane acrylate oligomer/monomer/adhesive promoter/photoinitiator/blue pigment and other additives
- allnex EBECRYL® product range can be used

1

#### UV/EB-curable coating instead of blue insulation tape for cell case

- Better production efficiency
- Better electrolyte resistance
- Better shear strength

2

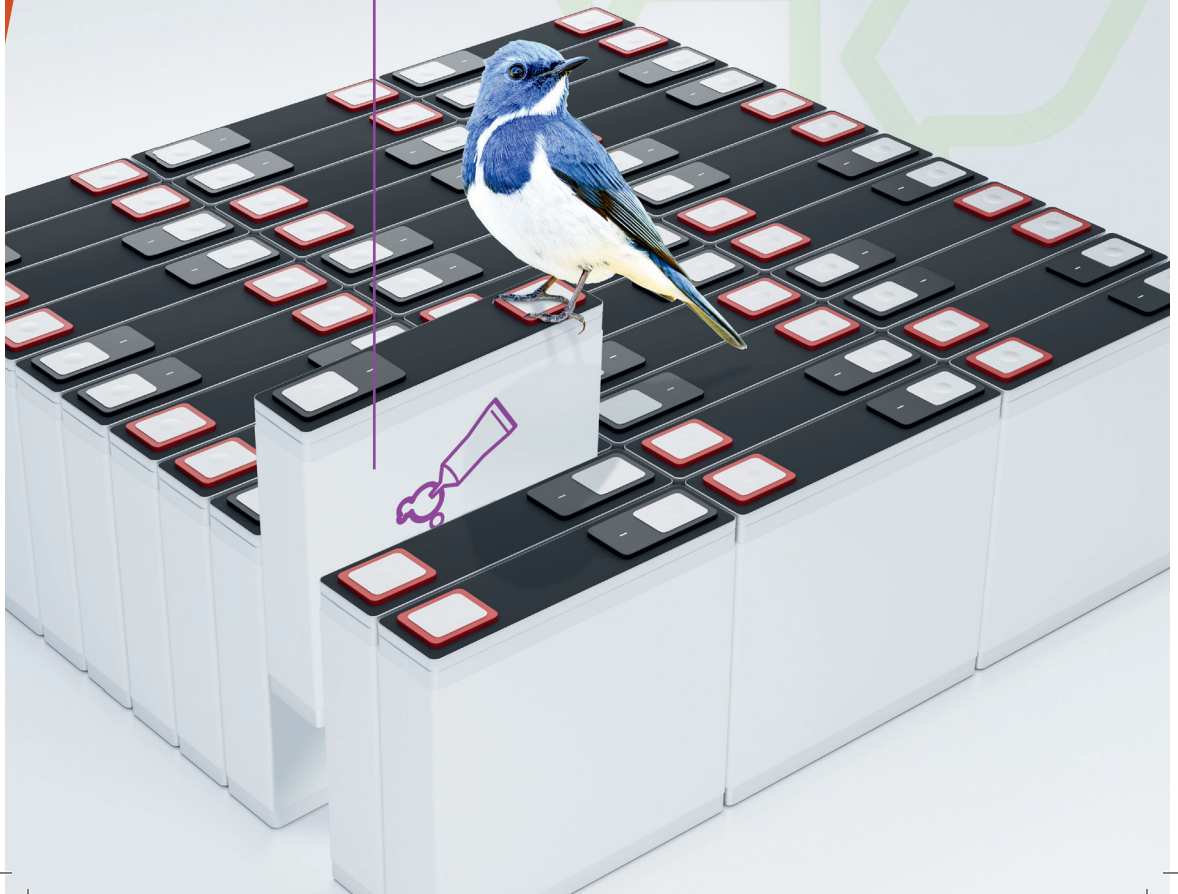
#### UV/EB-curable coating instead of powder coating for cell case

- Safer protection for case (applied after cell assembly/can cover all sides)
- Energy savings
- Easier to rework if needed
- Higher first-pass yield



**Hydrophobic polyols for 2KPU battery pack adhesive:**

- Bio-based and 100% active component
- Good adhesion strength to metal and cell insulative film
- Good elongation and tensile strength
- Good resistance to hot humidity
- Various grades available with viscosity from low to high and suits formula of adhesive with different thermal conductivity





Allnex Management GmbH  
The Squire 13, Am Flughafen  
60549 Frankfurt am Main, Germany



Contact:  
**May Zeng**  
Email: [may.zeng@allnex.com](mailto:may.zeng@allnex.com)  
Phone: +86 216404 8011 ext. 524



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