Alternative Binder of PVDF

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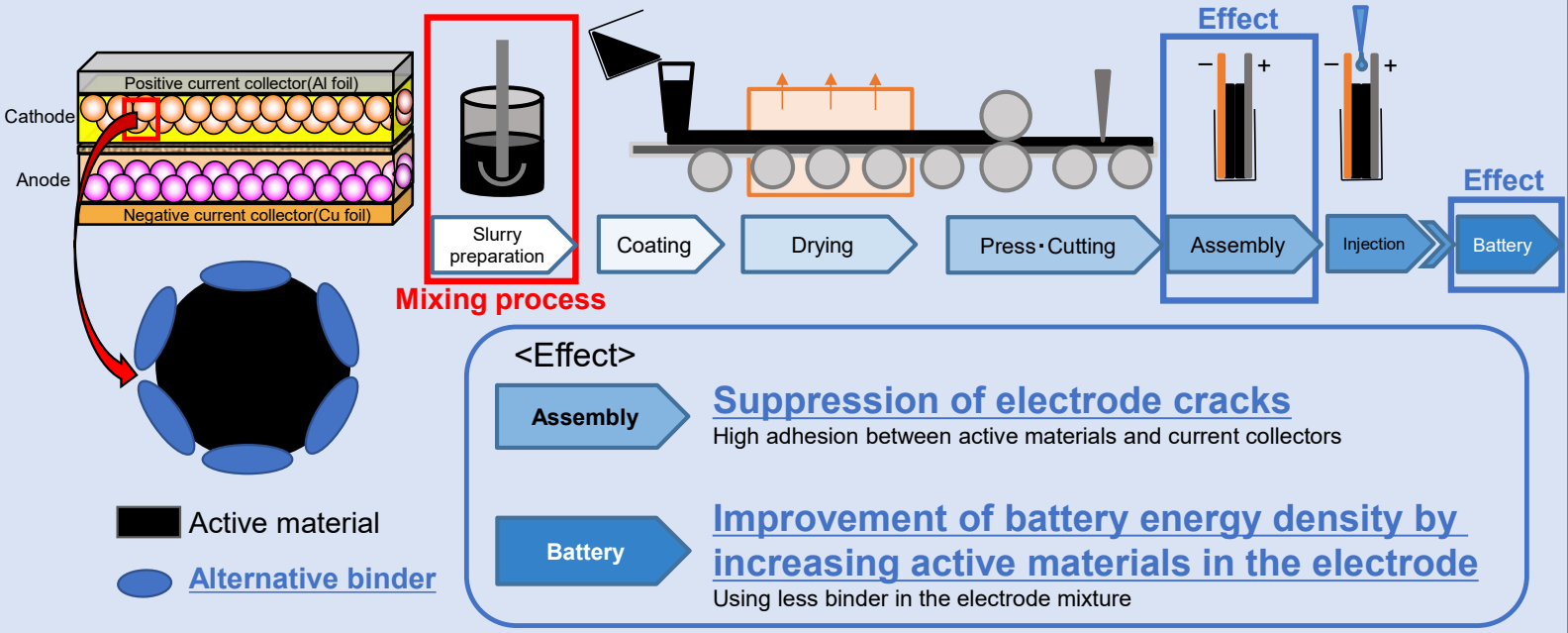
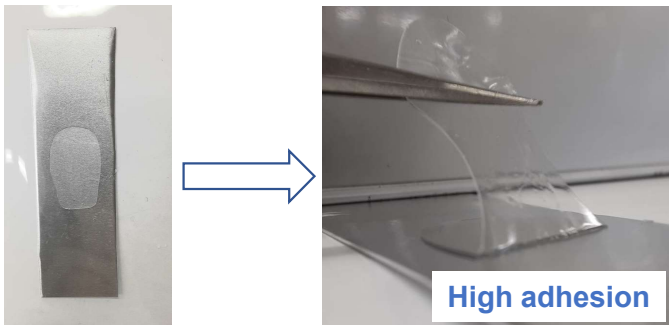


<Effect>

Assembly — **Suppression of electrode cracks**
High adhesion between active materials and current collectors

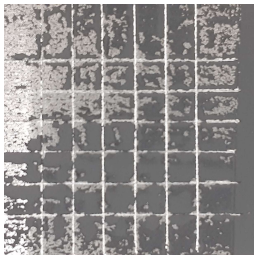
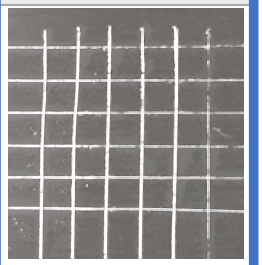
Battery — **Improvement of battery energy density by increasing active materials in the electrode**
Using less binder in the electrode mixture

Improvement of electrode adhesion to current collector



Detachment of alternative binder from Al substrate

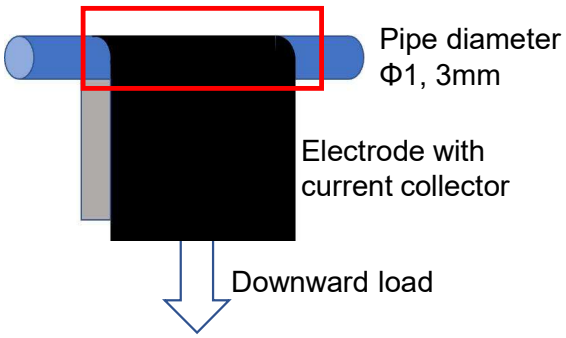
Adhesion comparison between Al current collector and electrode by cross-cut test

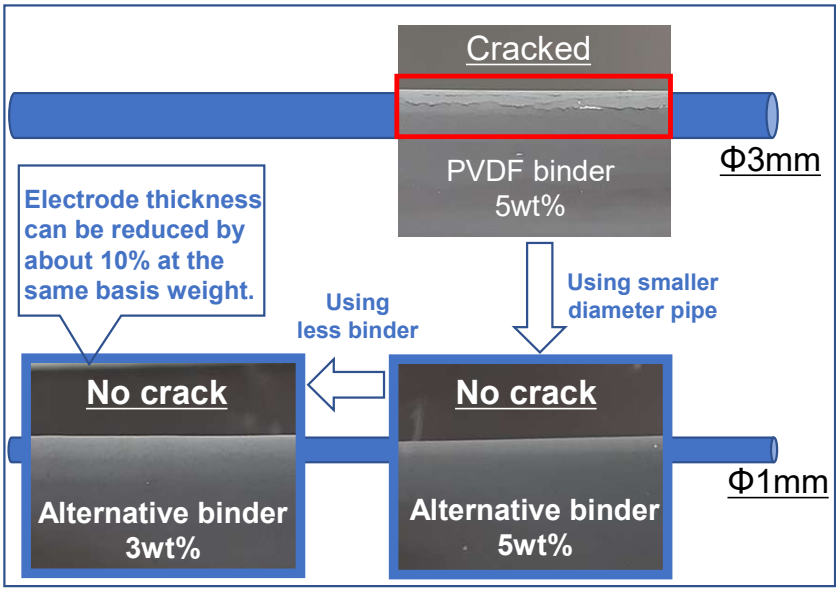
	NCA/AB/ PVDF binder	NCA/AB/ Alternative binder
Composition ratio	90/5/5 wt%	90/5/5 wt%
Appearance of cross-cut area		
Evaluation	Not good	Good

Less peeling from the current collector than PVDF binder due to its high adhesion

Suppression of electrode cracks

<Measurement method>





Suppressing the occurrence of electrode cracks even when the amount of alternative binder is reduced.

For more information please reach out to mobility@nagase.eu

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Side Reaction Suppressing Binder

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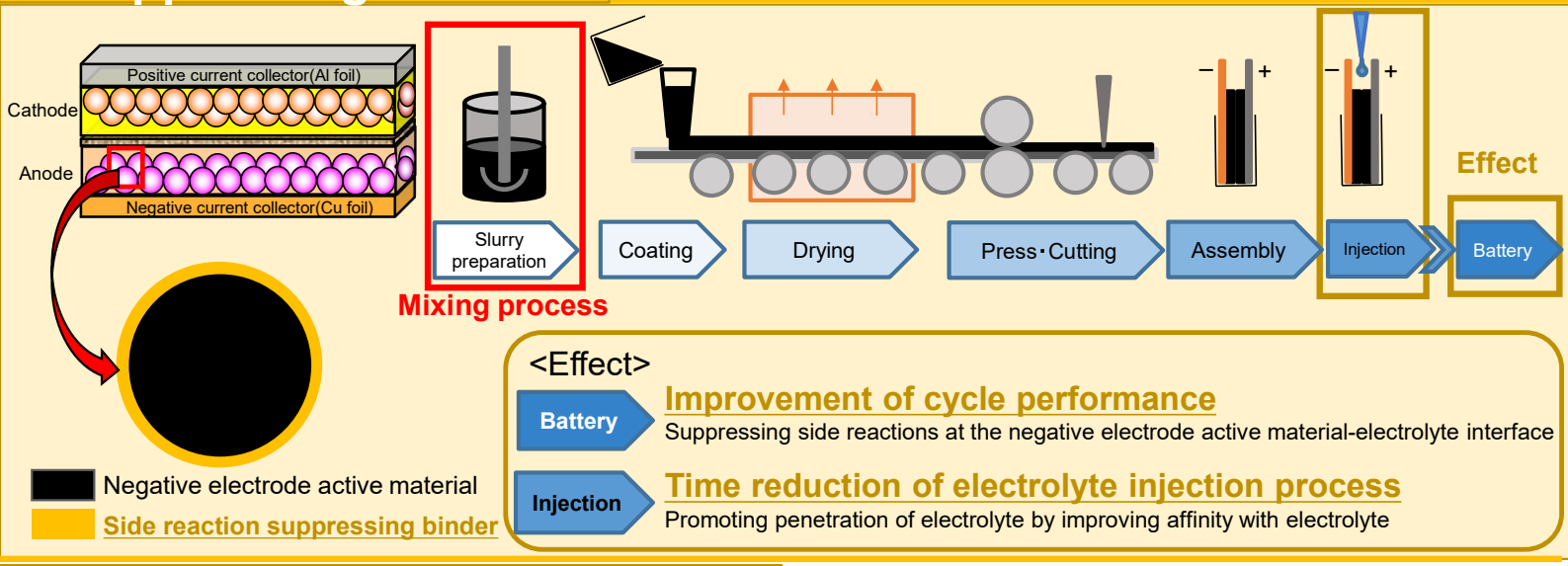


Negative electrode active material

Side reaction suppressing binder

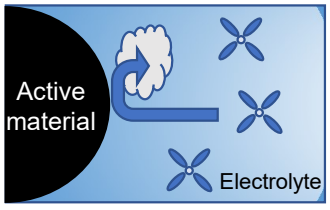
<Effect>

Battery — **Improvement of cycle performance**
Suppressing side reactions at the negative electrode active material-electrolyte interface

Injection — **Time reduction of electrolyte injection process**
Promoting penetration of electrolyte by improving affinity with electrolyte

Mechanism of side reaction suppression

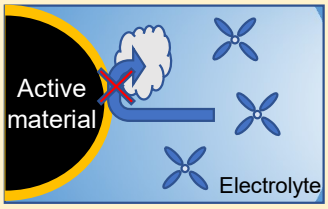
<Without Binder>



By-products

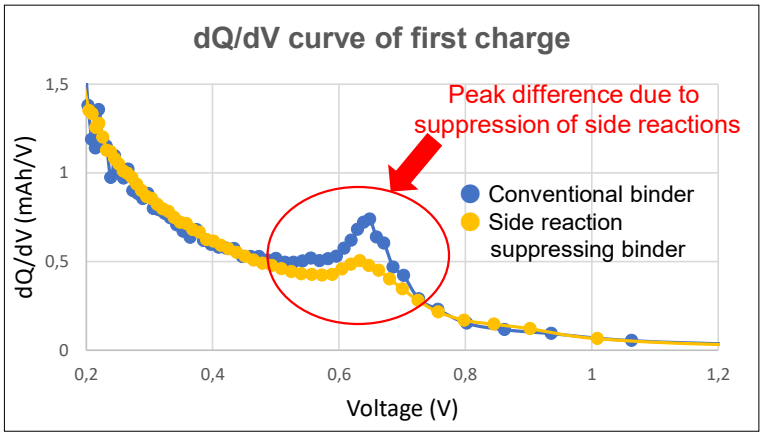
Side reactions progress on the active material surface.

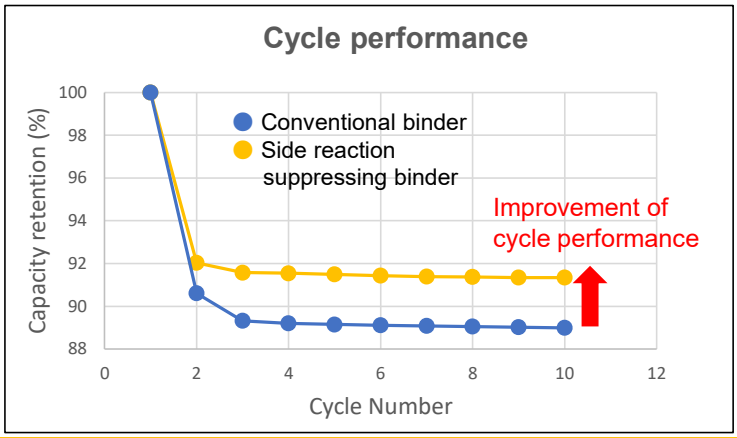
<With Binder>



Side reaction suppressing binder

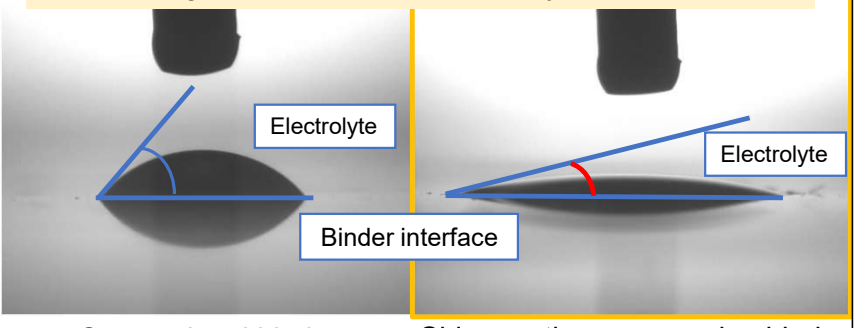
Suppressing side reactions at the negative electrode active material-electrolyte interface because binder coats active material.



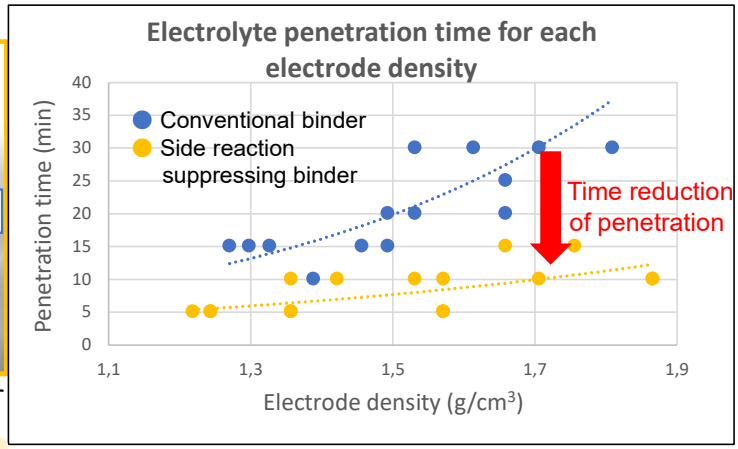


Promotion of electrolyte penetration

Contact angle measurement at electrolyte-binder interface



Conventional binder | Side reaction suppressing binder



Reduced contact angle by improving affinity with electrolyte

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Electrolyte Penetrant

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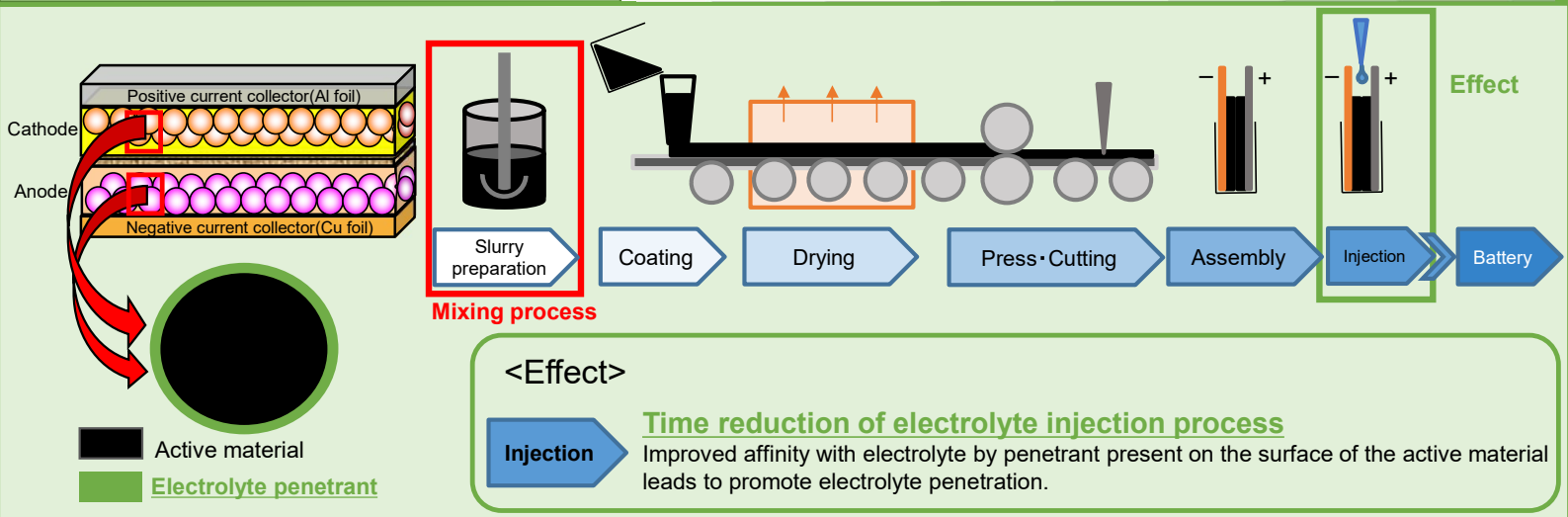


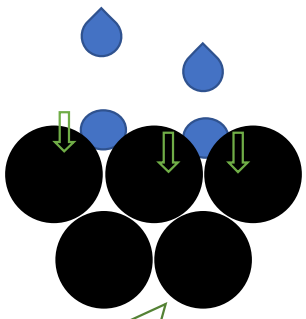
<Effect>

Injection — **Time reduction of electrolyte injection process**

Improved affinity with electrolyte by penetrant present on the surface of the active material leads to promote electrolyte penetration.

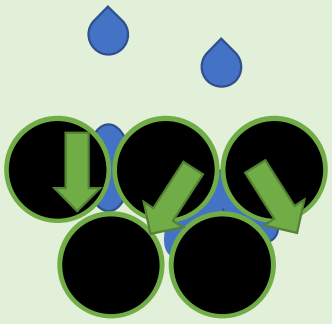
Promotion of penetration by improving affinity with electrolyte

<Without penetrant>



Low affinity between electrolyte and active material leads to be difficult for electrolyte to penetrate.

<With penetrant >



High affinity with electrolyte coats the surface of active material and promotes penetration.

<Without penetrant> <With penetrant>

Immediately after dropping

3 min. after dropping

15 min. after dropping

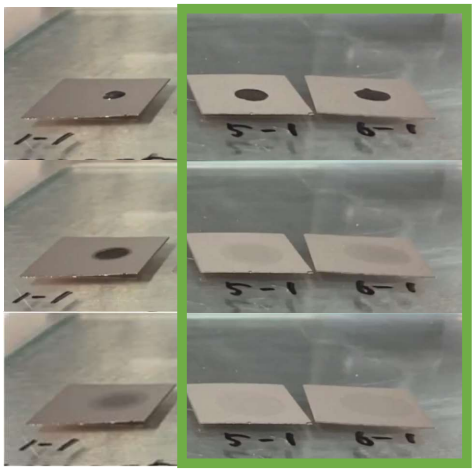
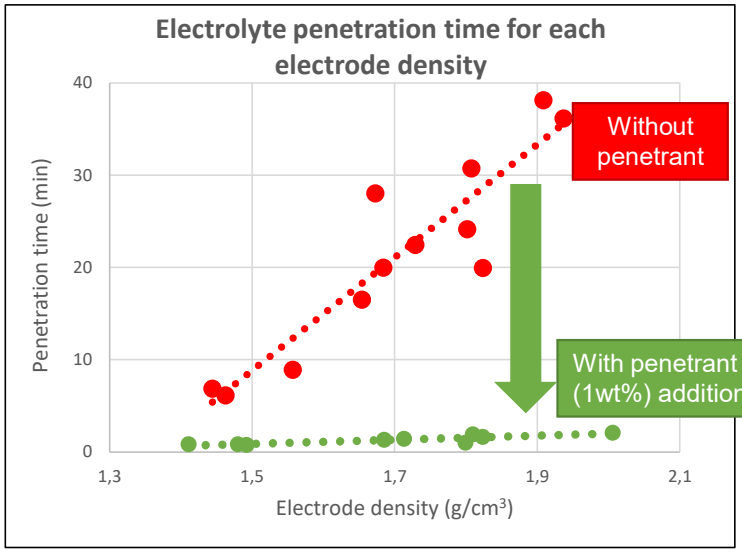


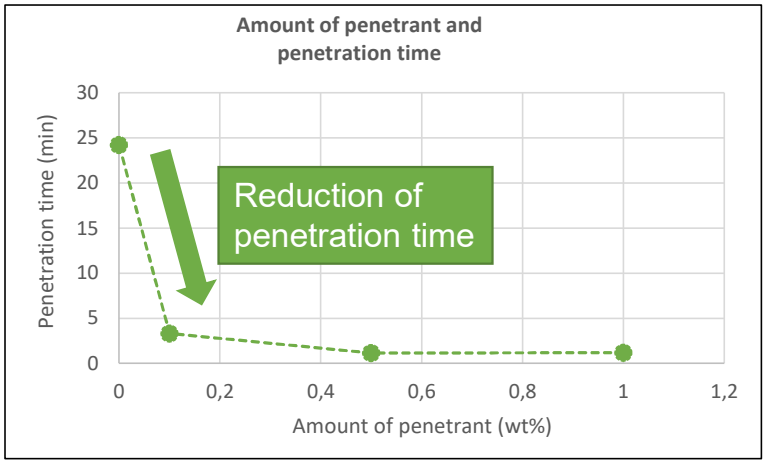
Image of dropping electrolyte to penetration into the electrode

The penetration speed of electrolyte is improved, and the time until the solution disappears is shortened.

Reduction of electrolyte penetration time



This penetrant enables to reduce penetration time significantly.



Addition of only 0.1wt% is effective to electrolyte penetration.

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Output Improver

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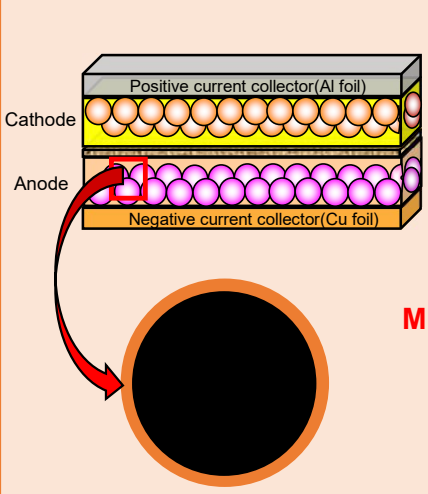
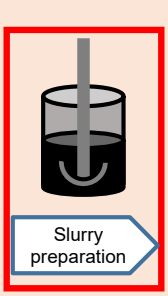




Slurry preparation → Coating → Drying → Press・Cutting → Assembly → Injection → Battery

Effect

Mixing process

Negative electrode active material

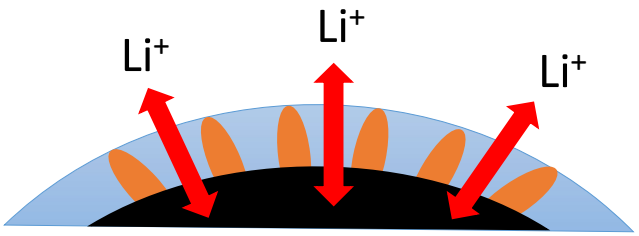
Output improver

<Effect>

Battery **Improvement of rapid charge/discharge performance**

High ionic conductivity promotes Li^+ transference.

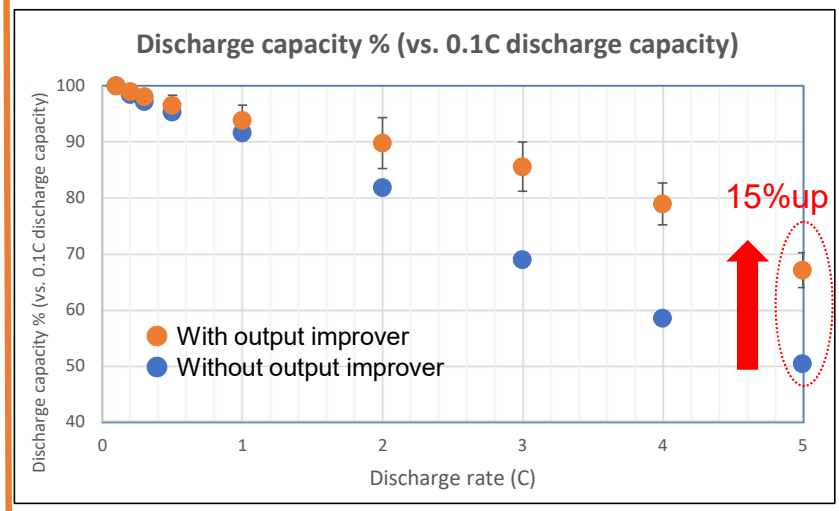
Mechanism of improving ionic conductivity



Active material SEI Output improver

Assumed to promote Li^+ transference through the ionic conduction parts of the output improver.

Improvement of rapid charge/discharge performance



About 15% increase in capacity at 5C discharge.

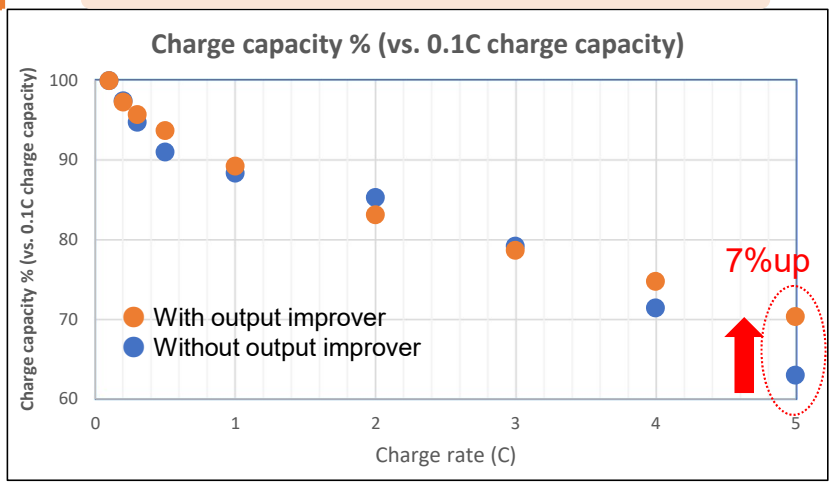
Appearance of electrode surface after rapid charge /discharge (at 5C discharge)

Without output improver

With output improver

Li^+ precipitation is observed on the electrode surface due to high resistance.

Promoting Li^+ transference leads to suppress Li precipitation on the electrode surface.



About 7% increase in capacity at 5C charge.

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Polymer-Coated Active Material

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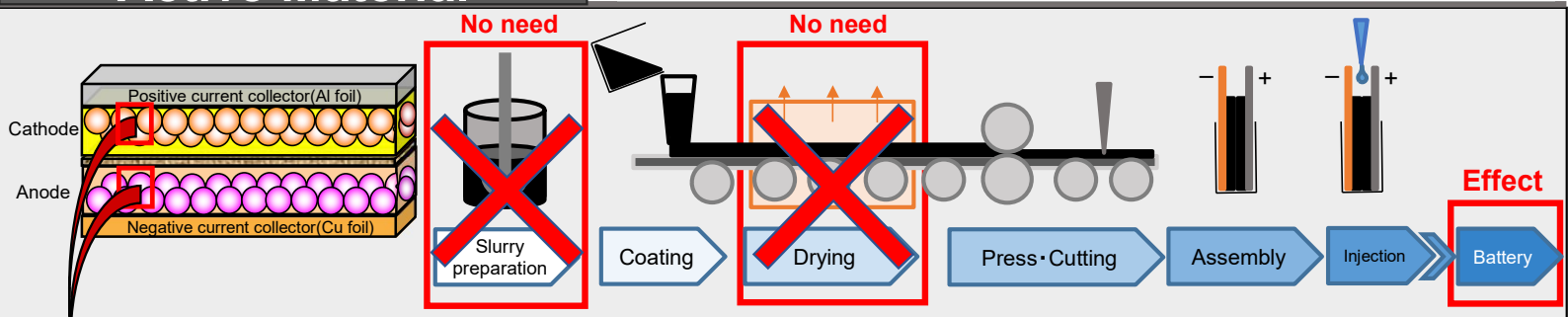
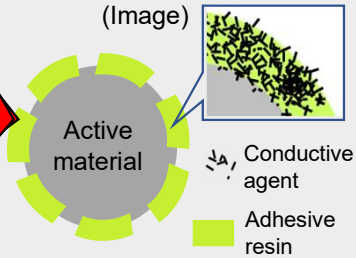


Polymer-coated active material (Image)



<Effect>

Slurry preparation / Drying

High-efficiency production line of battery manufacturing

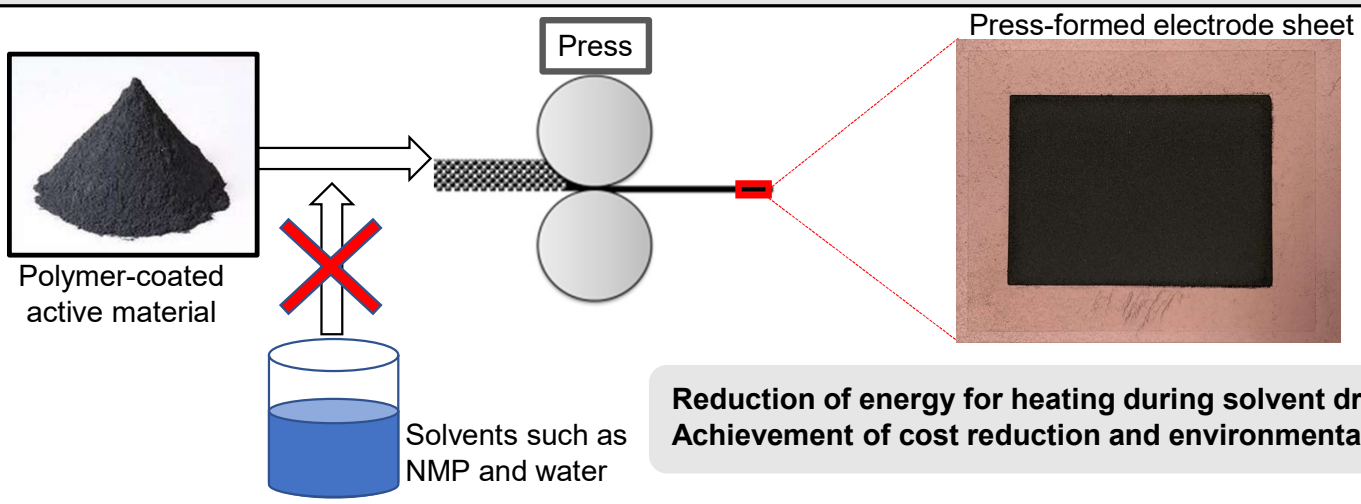
The surface of active material is coated with conductive agents and adhesive resin leads to fabricate electrodes only by pressing.

Battery

Improvement of battery energy density by thick electrodes

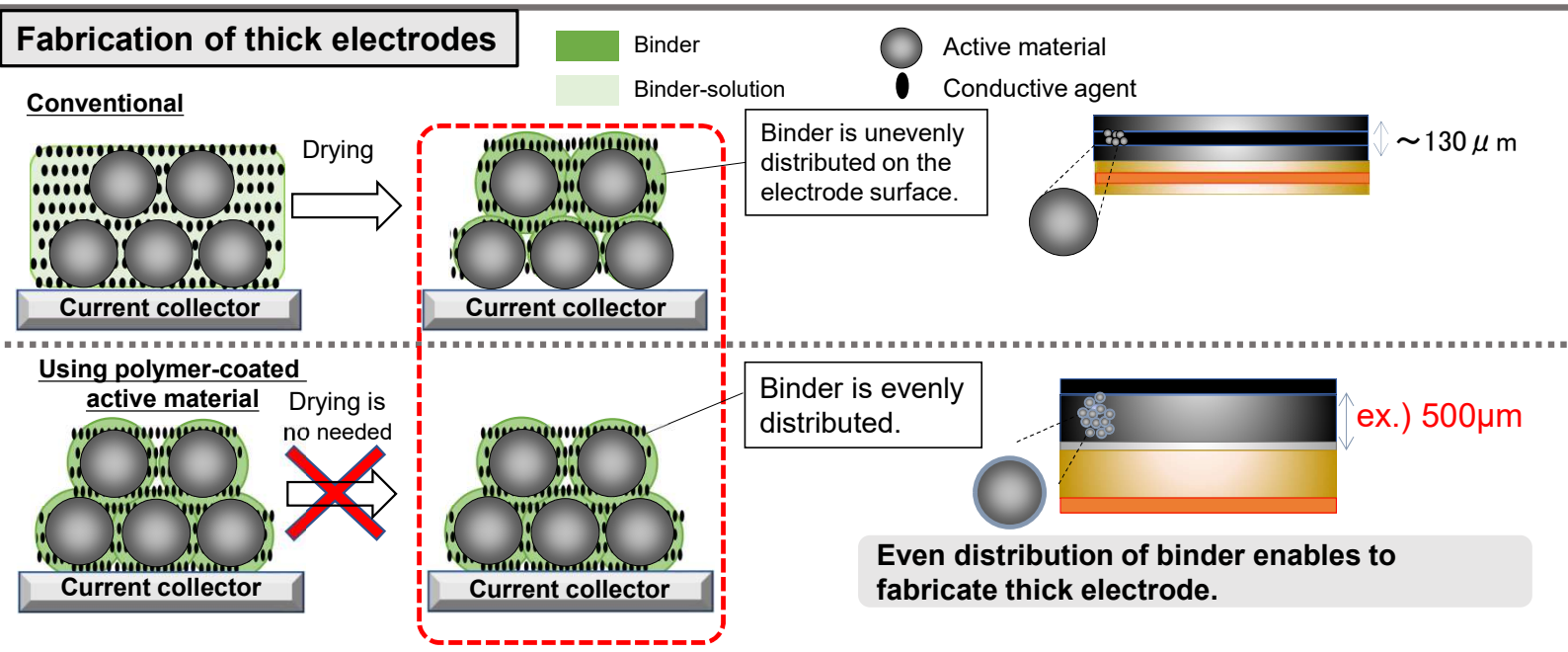
Prevention of uneven distribution of binder by eliminating drying process
Improvement of the ratio of electrodes in the battery

High-efficiency production line of battery manufacturing by using polymer-coated active material



Reduction of energy for heating during solvent drying
Achievement of cost reduction and environmental protection

Fabrication of thick electrodes



Even distribution of binder enables to fabricate thick electrode.

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