

The background of the slide is a dark, blurred image of a car, likely a sedan, in a factory or showroom setting. The car is dark-colored, and the background shows some industrial equipment and lights, creating a bokeh effect.

COATING

SOLUTION 4 U

Technical Introduction

January 2025

Brief Introduction on CoatingSolution4U

CoatingSolution4U, co-founded by two leading experts in coating processes in February 2023, is dedicated to creating a sustainable planet through our innovative fluid diagnostics and nanothin film coating technology across various industrial sectors.



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Prof. Kyung Hyun CHOI

- Professor of Mechatronics Engineering, Jeju National Univ.
- Ph.D in Mechanical engineering, University of Ottawa

Issues in Electric Vehicle Market

Issues

Productivity

Smart Factory

Explosion,
Fire Risk

Lithium Metal

Innovative
Technology

Solutions

1. Enhancing **Quality Stability and Productivity** in Electrode Manufacturing through Real-Time Slurry Diagnostics Solution
2. Improving Battery Separator Performance and Electrolyte Impregnation Speed Using R2R ALD Technology

Automation of Manufacturing Processes Enabled by Real-Time Diagnostics

Fire Prevention by Applying R2R ALD on Electrode Surfaces

Overcoming Technical Limitations through R2R ALD Coating on Electrode Surfaces

NanoXpert



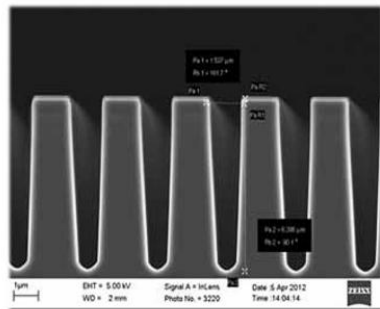
Roll-to-Roll Atmospheric Pressure ALD

Roll-to-Roll Atmospheric Pressure ALD - NanoXpert

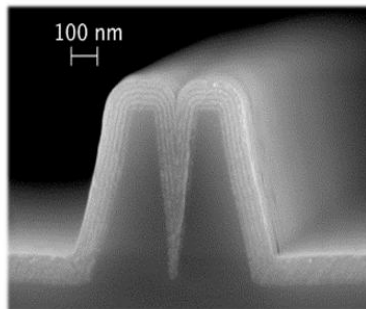
Atomic Layer Deposition (ALD)

- ALD is a technique for coating metal oxides with nanometer precision on solid surfaces, widely used in semiconductor manufacturing processes.
- Traditional ALD technologies require high-vacuum and high-temperature environments, making continuous processes unfeasible.
- Our proprietary technology enables ALD **under atmospheric pressure and low-temperature conditions, allowing for roll-to-roll (R2R) continuous processing, which is ideal for mass production.**
- We currently hold **8 patents and have 2 patents pending** related to this atmospheric pressure R2R ALD technology.
- Our goal is to scale up this technology, develop pilot and mass-production equipment, and implement it in commercial production lines.

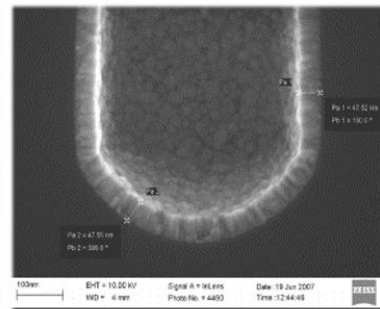
High Aspect Ratio



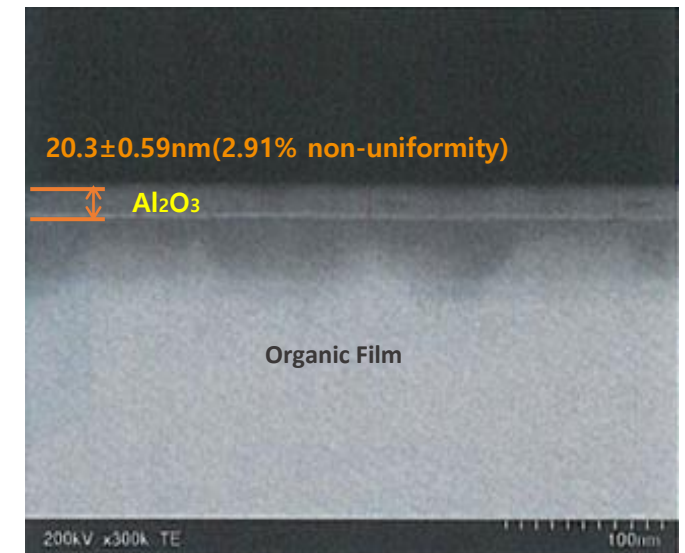
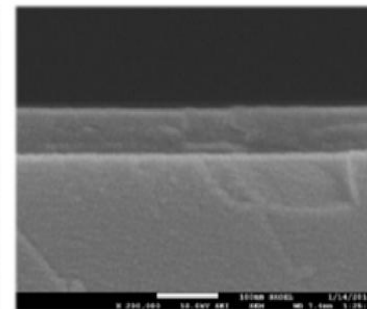
Conformal Coating



Excellent Step Coverage



Uniform Thickness



CS4U's R2R Atmospheric ALD

Applications – Surface Coating on Membranes (Reducing electrolyte injection time)

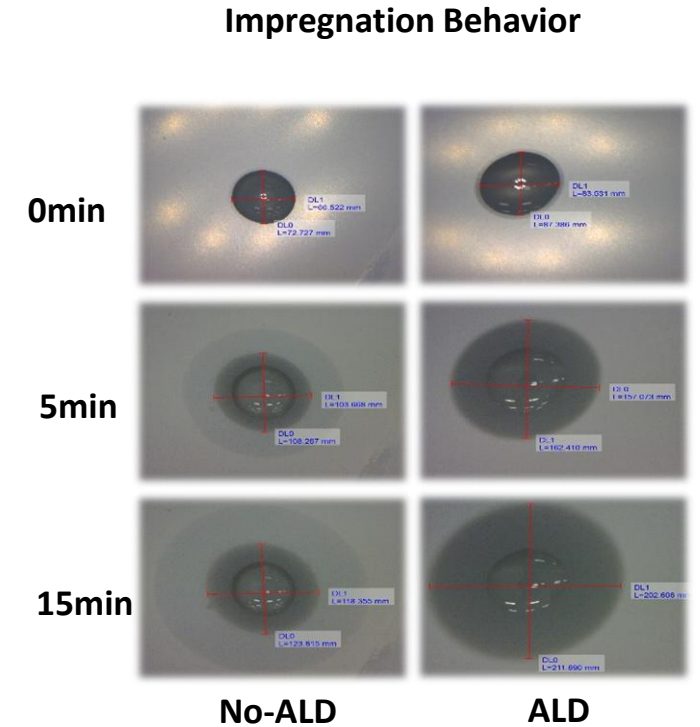
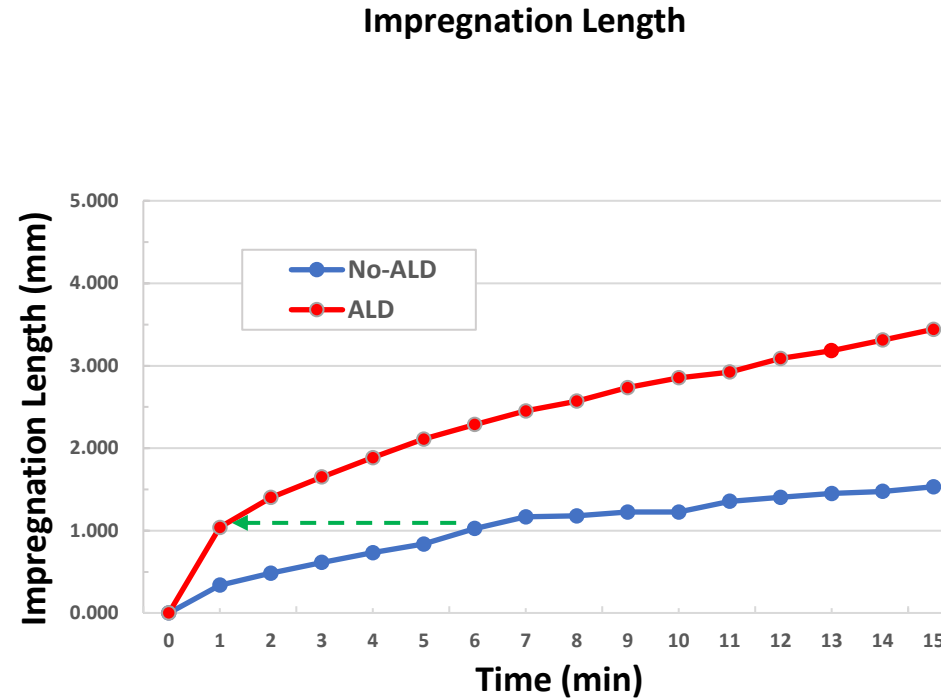
Improvement of electrolyte wettability due to Al₂O₃ coating, leading to shortened electrode manufacturing process and time

Test Conditions

- 80°C, 2m/min
- Specific TMA/H₂O rate using CS-ALD System
- To measure impregnation distance and time using Propylene Carbonate

On-going Projects

- Test on Client B's battery separator: Criteria reached at 1mm wetting distance. **Reduced from 6 minutes (No-ALD) to 1 minute (ALD).**
- **Completed Coating of 180m Separator Roll: Performance Testing Underway After Cell Manufacturing**
- Separator Testing for Company E: High-Performance Separator Development Project in Progress (Evaluation Underway After Coating a 100m Separator Roll)



Applications – Surface Coating on Electrodes (Suppression of dendrite formation)

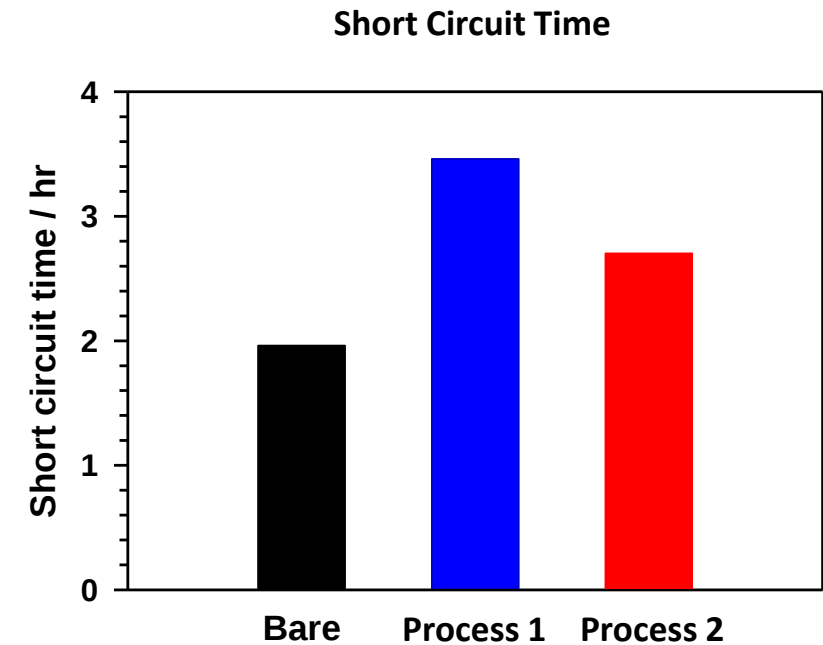
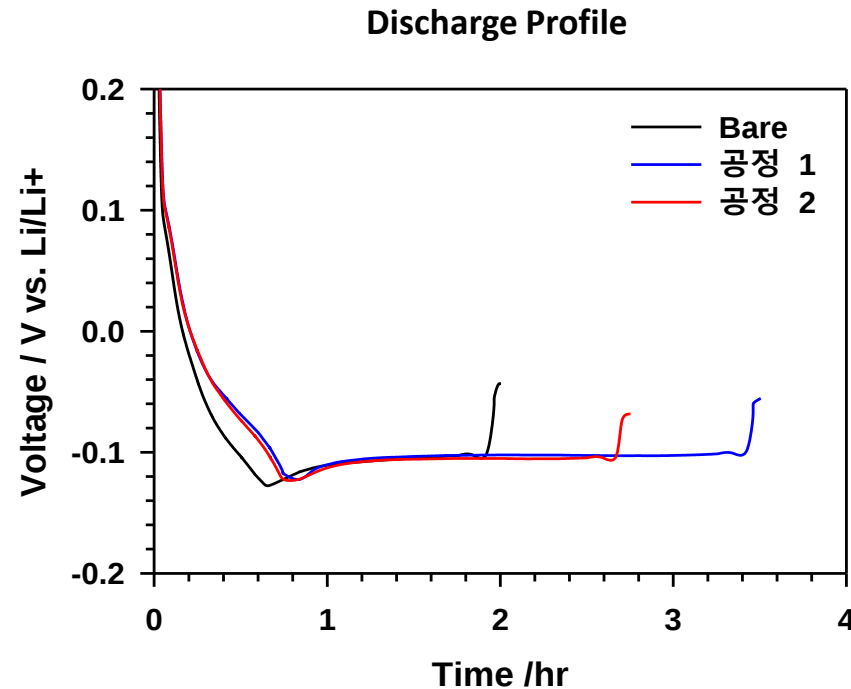
Coating graphite electrodes with Al₂O₃ is considered to inhibit lithium dendrite growth on the surface

Test Purpose

To verify the dendrite inhibition effect of Al₂O₃ coating, Comparison of time to short circuit occurrence when applying a specific current

Test Conditions

- EL : 1.3 M LiPF₆ EC/EMC/DMC 3:4:3
- Discharge : 1 C (360 mA g⁻¹)



It has been confirmed that the time to short circuit occurrence is delayed on Al₂O₃-coated electrodes compared to bare electrodes

Applications – Surface Coating on Electrodes (Suppression of dendrite formation)

Li eduction was completely suppressed from 4.1% to 0.0% with Al2O3 coating

Test Purpose

Performance Comparison Between Reference
Batteries and ALD Al₂O₃-Coated Batteries

Coating Conditions

- 2nm Al₂O₃ with NanoXpert

Evaluation of ALD coating on Anodes

Sample test result shows that Al₂O₃ coating contributes to improved Li eduction

Characte ristics	Item		Ref.	ALD coated
	FCE (%)		88.5	89.9
	Wetting time (s)		19	2
	Li eduction (%)		4.1	0

"This material has been extracted from the client's test report, with confidential
information concealed and translated into English."

Other Applications



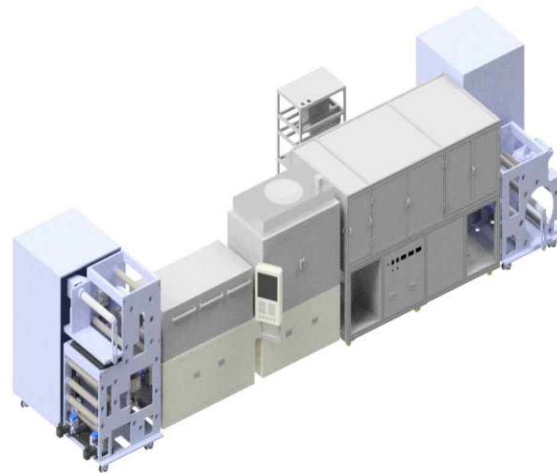
Green Energy

- **Battery (Electrode coating, Separator coating)**
- Solar energy (OPV, perovskite)



Electronics

- Barrier film
- Packaging coating
- Imaging sensor
- RF devices
- Anti-reflection coating
- PCB/Assemblies
- PCB Via hole



Precision manufacturing and interior design

- Machinery Parts (Automotive parts)
- Interior film
- Architectural interior materials



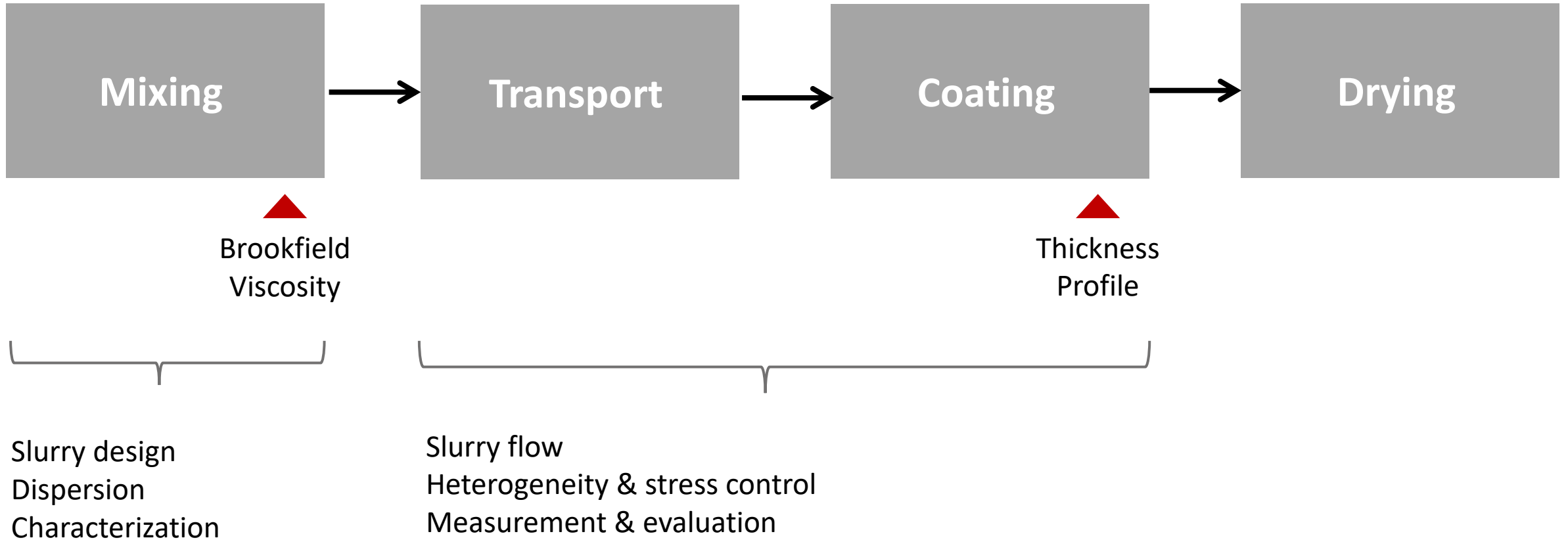
Medical Industry

- Surgical/electrosurgical instruments
- Stent
- Neurological devices/Heart pacemaker devices
- Hearing aid devices
- Dental implants

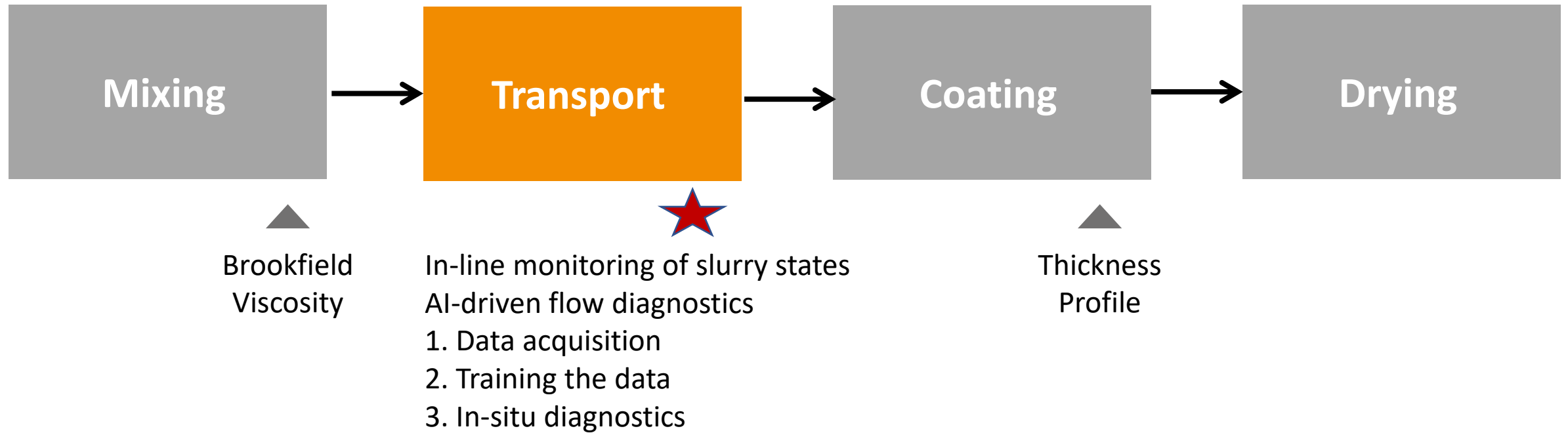
SlurryXpert

**AI-based Online Real-time Slurry
Diagnostics Solution**

Challenges in Electrode Manufacturing: Low Yield



Challenges in Electrode Manufacturing: Low Yield



Suggestions & Benefits

Suggestions

- On-site Seminar and Discussions
- Consulting Current level of Processing Technology
- Projects; Slurry Diagnostics in Pilot or Production Line

Benefits

- Evaluate Your Technology Level Compared to Competitors
- Gain Advanced Insights into Slurry Flow
- Optimize Systems to Enhance Yield and to Surpass Competitor