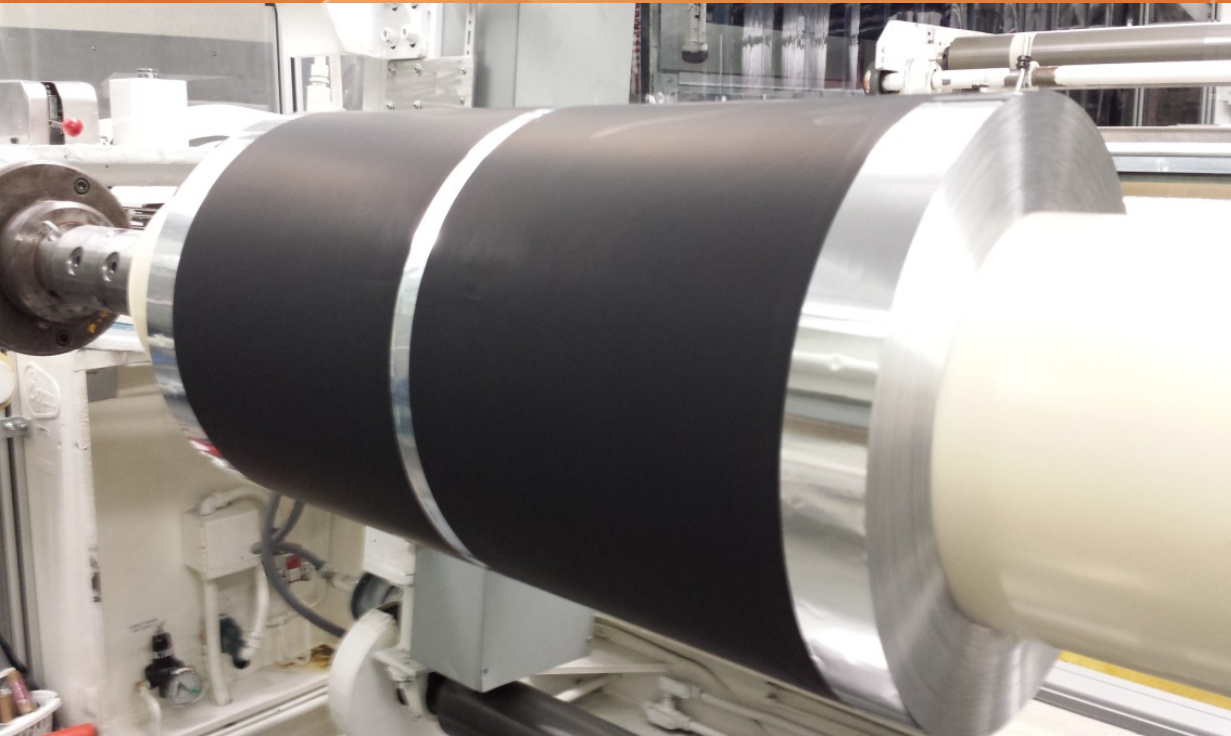


Simultaneous Multilayer Coating for Batteries



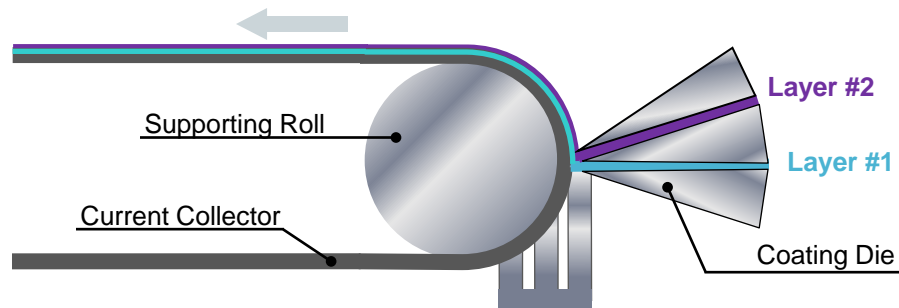
Enabling higher performance
at reduced cost through
processing innovation

Carestream

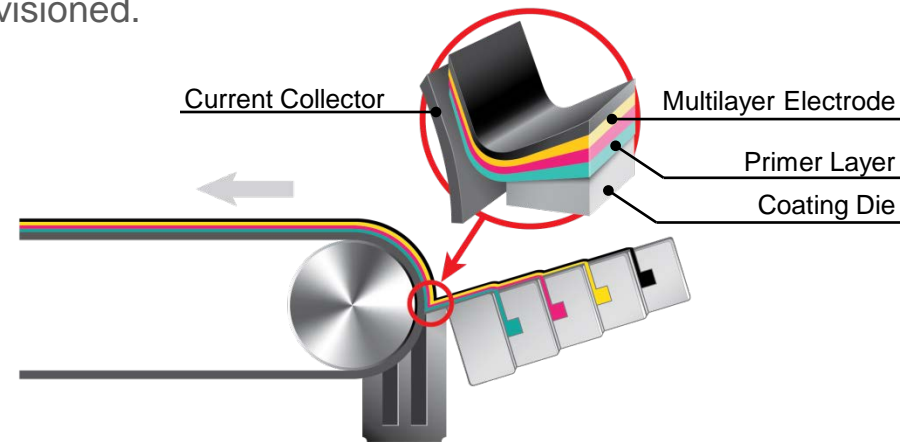
Multilayer Coating Value Proposition

Simultaneous Multilayer Coating (MLC) can improve performance and reduce cost:

- Enables design freedom to solve problems and improve performance via additional layers
 - Hybrid cathode systems to balance benefits and constraints of independent systems
 - Porosity gradient to enable thicker, energy rich electrodes without compromising charge rates
 - Bottom layer NMC 811 / top layer NMC 532 to enable higher energy density with reduced electrolyte fouling
 - Alternating silicon and carbon layers to manage expansion while increasing silicon content / energy density
 - Coated SEI layer to protect electrodes and increase cycle life
- Enables additional layers without additional passes (cost) through the coating machine
- Imagine coating a primer, a multilayer electrode, and a ceramic separator on both sides of the web in a single pass. A multitude of design ideas can be envisioned.



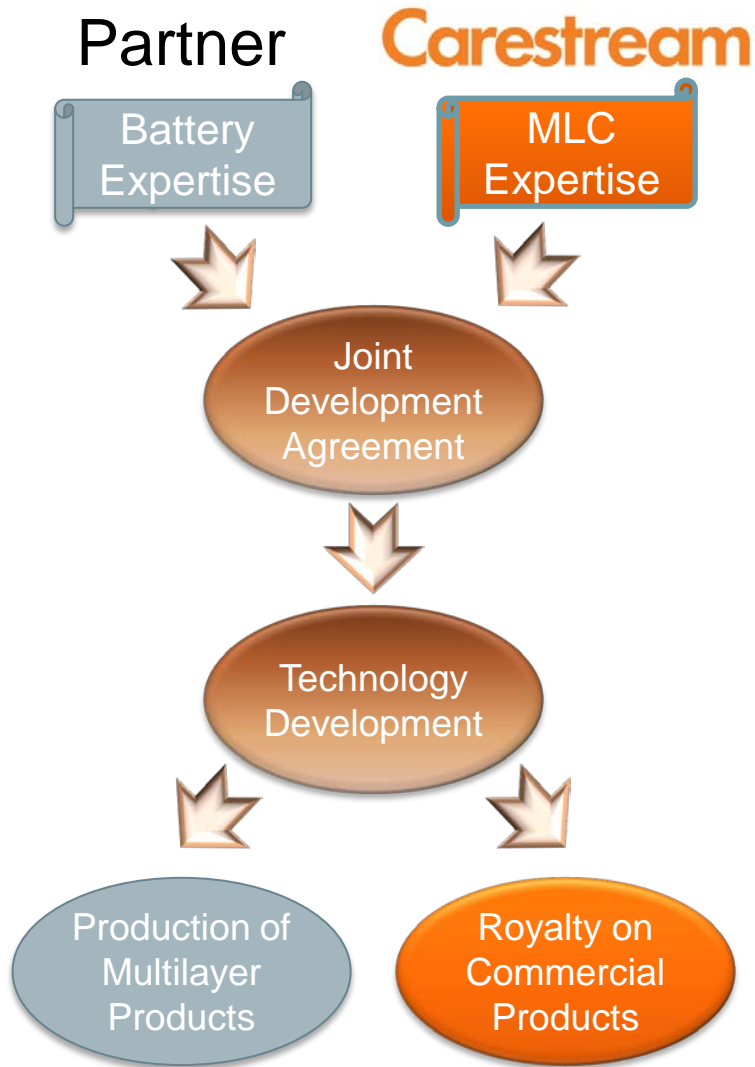
Dual slot die coating



Slide coating

How will you use Multilayer Coating to deliver competitive advantage?

Partnership Strategy



What

- Partner expertise in battery materials
- Carestream expertise in multilayer coating
- Combine to bring significant value to both companies through performance improvements at reduced manufacturing costs

How

- Enter into a JDA to create a technology package that includes IP, trade secrets, and know-how
- Tech development done jointly to combine critical expertise, reduce costs and drive speed
- Partner to utilize the technology to enable production of multilayer products on Partner's assets
- Options for pilot or full scale production, and technology transfer from Carestream

IP

- Shared IP related to stack design, chemistry and formulation required to enable multilayer coating will result from the JDA

Alternatives - Carestream is open to other approaches and business models

Why Partner with Carestream?

Manufacturing/Technology Partner with over 100 years in Coating Leadership

- Combining Eastman Kodak's Health Business and 3M-Imation Health Imaging Businesses
- Significant advanced materials coating expertise, experience, and assets
- Proven coating leader offering lab to production scale for high value, demanding products

High Speed Precision Coating on Flexible Substrates

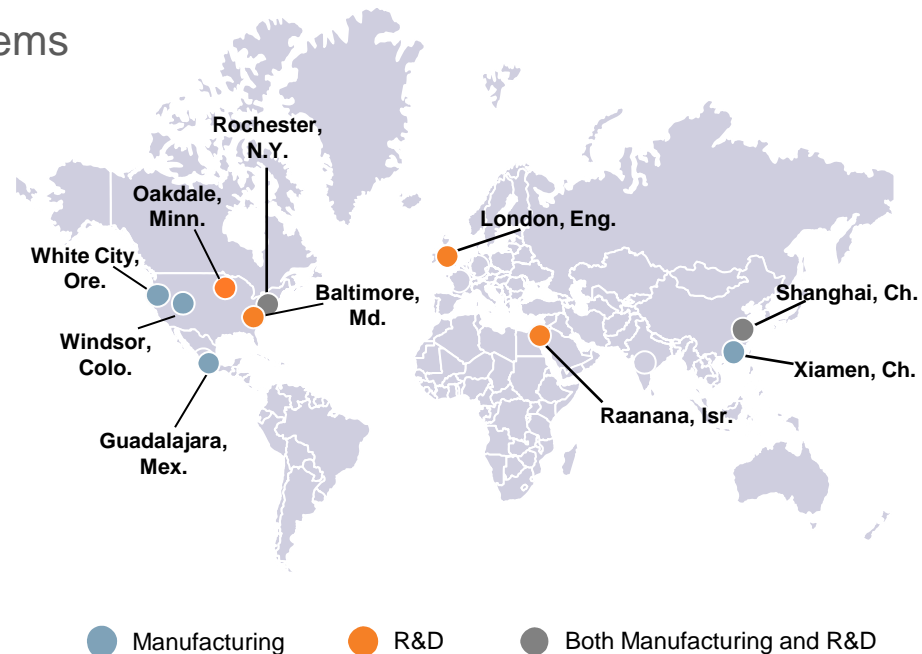
- Single and multi-layer roll to roll complex systems
- Aqueous and solvent-based systems

From Development to Commercial Scale

- Technology development collaboration
- Slurry/coating engineering for manufacturing
- Process design & implementation
- Exceptional Lean Six Sigma manufacturing

Partnership, Investment, and Capability

- \$1.5B company able to invest
- Ability to re-purpose assets for energy storage
- Many business models: capital investment, profit sharing, licensing, JDA, JV, acquisition, etc.



Multilayer Coating Case Studies

DRYVIEW Medical Laser Imaging Film

Process Requirements

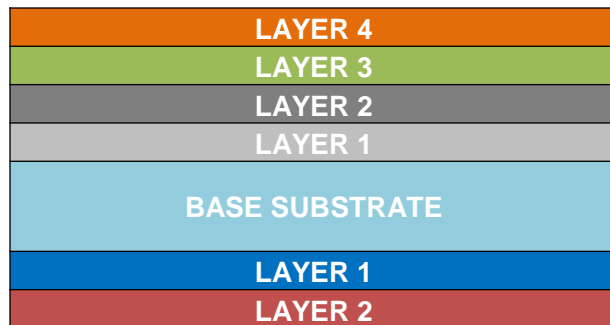
Coat both sides of the substrate
6 layers, single pass through the machine

Process Design Improvements

Increasing number of layers and moving from slot to slide increased line speed by 4x, increased yield, and improved performance

Results

World leader in laser imaging film
Over 1 billion m² coated since 1996



Moisture and O₂ Pharmaceutical Barrier Film

Process Requirements

Primer (adhesion promoter) + barrier layers
3 layers, single pass through the machine

Results

Reduced manufacturing cost at higher yields



Optical Display Film

Process Requirements

Dual layer (aqueous) at coating head #1
Dual layer (solvent) at coating head #2
4 layers, single pass through the machine

Results

Reduced manufacturing cost at higher yields and improved performance



Carestream has used MLC to deliver significant value to many industries
→ Why Not Batteries?

What Technical Value Does Carestream Offer?

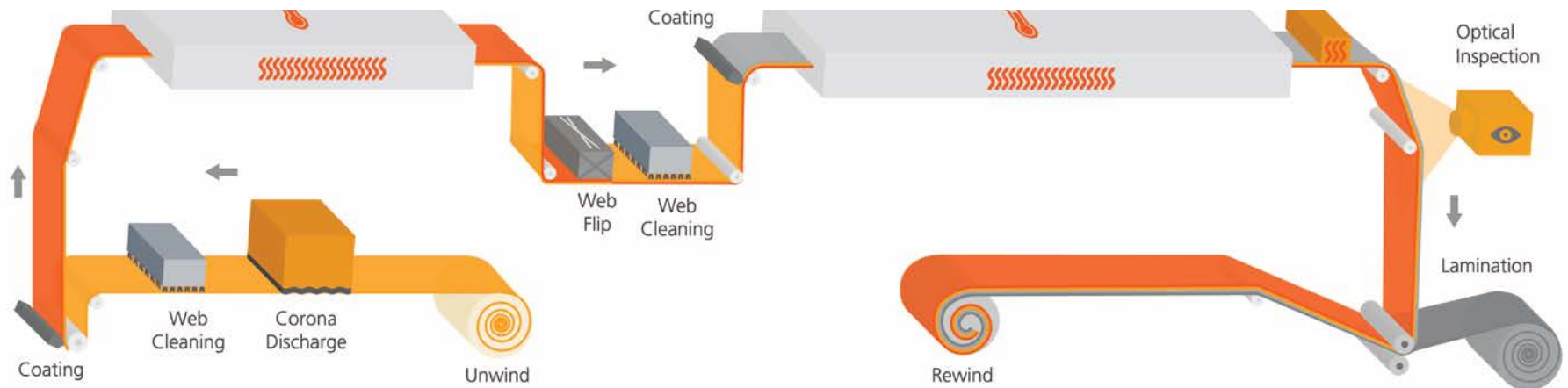
Multilayer Formulation and Coating Process Trade Secrets and Know-How

- Decades of engineering expertise to solve the most challenging problems
- Solution characterization and formulation:
 - Layers stability – interfacial tension, density, viscosity, diffusion and solubility
 - Formulation guidance for multilayer coating, including proprietary predictive coating modeling
 - Solvent and aqueous systems including solvent based slide coating unique to Carestream
 - Elevated viscosity range for slide coating up to 1,700cP and possibly beyond

Lab, Pilot, and Production Scale Assets with Operational Excellence

- Dynamic coating development and prototyping:
 - Layers stack and equipment design
 - Lab scale verification of layer stability, coating speed, and multilayer drying
 - Generation of small scale samples for functional testing
 - Analytical assessment of layer stability, defect analysis, and correction
- Pilot scale roll to roll process development:
 - Verification of scale up solution delivery, coating, multilayer drying, conveyance, and roll formation
 - On-line optical inspection of coated electrode
 - Evaluation and improvement of process stability and capability for production scale up
 - Produce low volume production to support prototype builds and customer sampling
- QC and analytical labs to support full product life cycle
- Technical and operational infrastructure to support full scale production of MLC product

Carestream Capability and Experience



**High-Speed, Continuous, Precision Coating
of Up to 8 Layers in One Single Pass**

Carestream

Manufacturing Excellence

World-Class Coating Facilities

- Solution Making
- Multilayer Coating
- Converting
- Analytical and Quality Testing

World-Class Suppliers and Supply Chain

- Cooperative Improvement Programs
- ISO 14001, 13485, and 9001 Certified
- CTIA Battery Certification

World-Class Employees

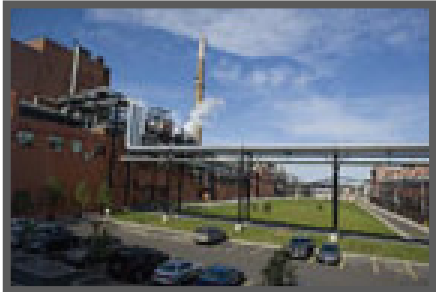
- High Performance, Involved Workforce
- Resources Include:
 - Chemists, Material Scientists, Coating Scientists (BS through PhD)
 - Chemical, Mechanical, Electrical, Material, Process, Coating, Converting, Packaging, and Systems Engineering
 - Purchasing and Supply Chain Management

World-Class Results

- Comprehensive Manufacturing Strategy: Health, Safety, Environment, Quality, Productivity, Delivery, Cost, and Inventory



Manufacturing Locations



Oregon, US

(Pilot, Production, Mixing, Converting)



Colorado, US →

(Coating Assessment Lab, Production, Mixing, Converting, PET manufacturing)

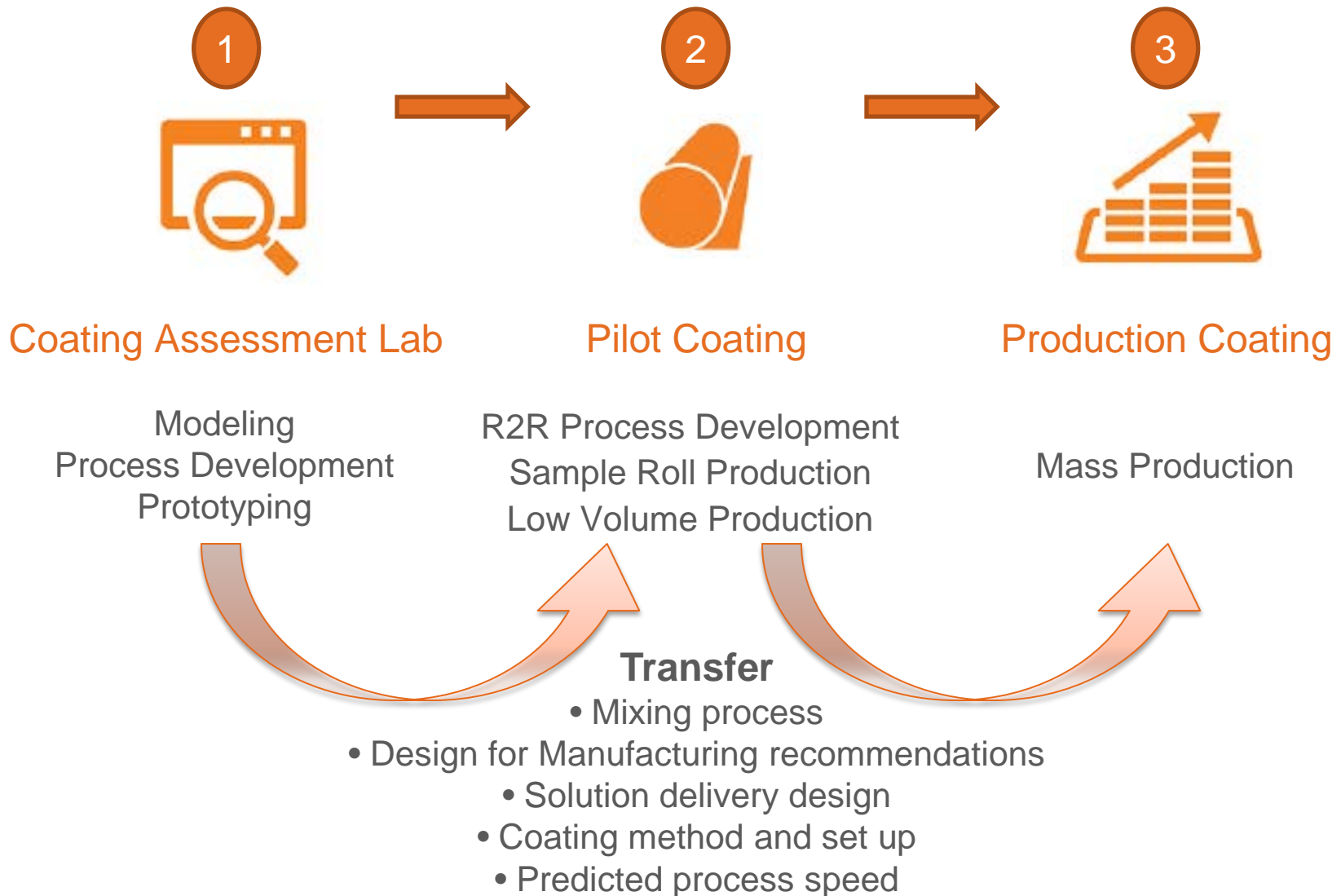
Xiamen, CH →

(Slitting, Sheeting, Packaging)



Over 100 Years of Precision Coating Leadership

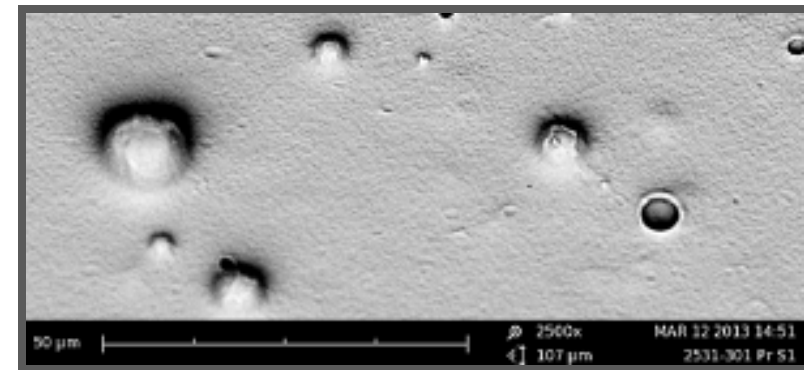
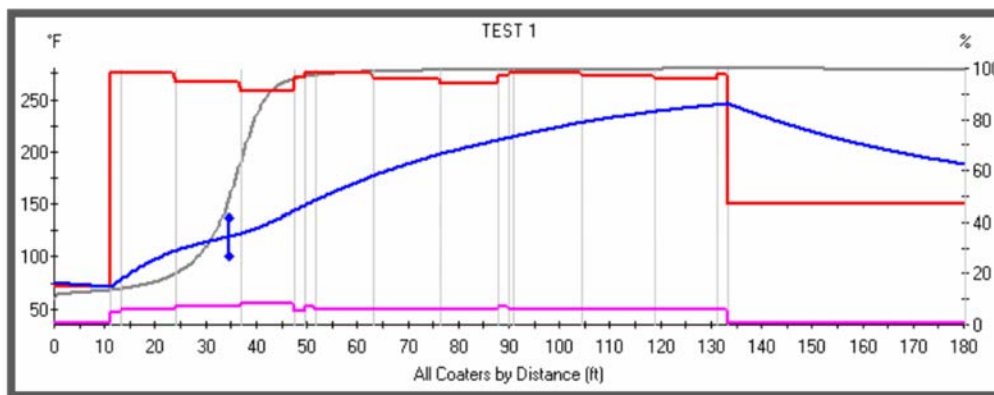
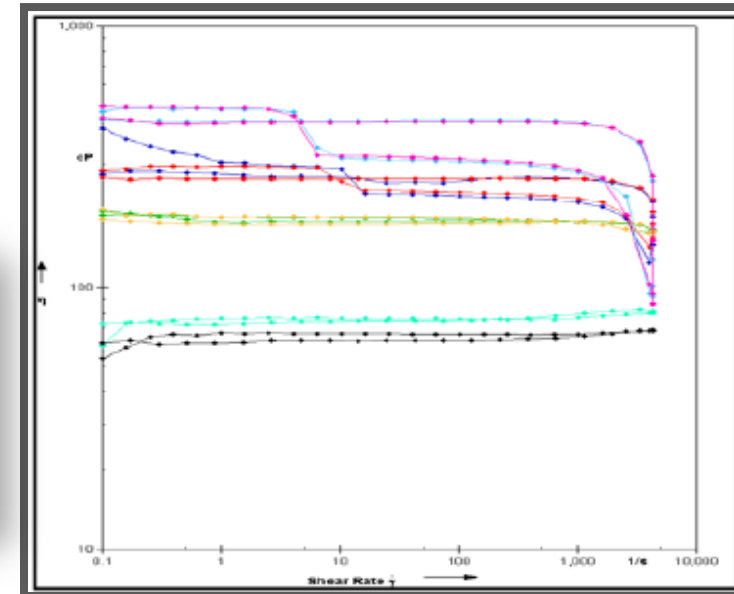
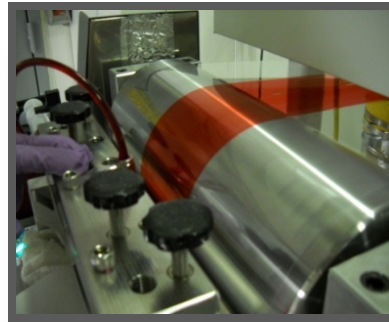
From Process Development to Production



Coating Assessment Lab (CAL)

CAL capability

- Solution Characterization and Formulation
- Solution Mixing and Delivery
- Multilayer Stability Evaluation
- Support Characterization
- Coating
- Drying and Curing
- Coated Sample Testing
- Microscopy
- Process Modeling



Pilot & Production Coaters

Pilot capabilities

- Widths from 4" to 12", speeds from 4 fpm to 200 fpm
- High efficiency multi-zone drying up to 375F

Production capabilities

- Widths from 24" to 58", speeds from 50 fpm to 450 fpm
- Two coating stations – one or both sides
- 1 to 8 layers in single pass
- 3 to 6 zones drying up to 300F and 1,400ft of drying path

Pilot & Production capabilities

- Solvent and aqueous solutions
- Temperature controlled solutions and coating
- CDT, web cleaning, UV curing, lamination
- 100% optical inspection to 25 micron resolution
- Real time process control and feedback and analysis
- Variety of coating technologies (slot die, slide, curtain, gravure, etc.)
- Highly uniform < 2% to 5% thickness variability
- Class 100 clean room capable coating and web path
- Slitting capabilities



Solution Making & Delivery

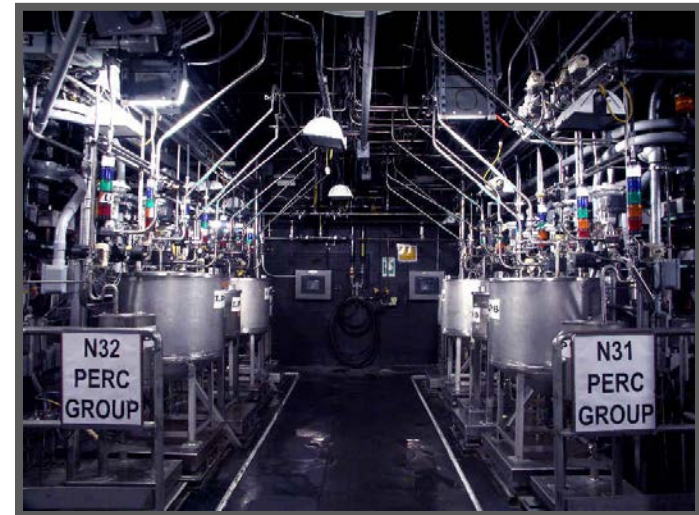
Solution Making

- Stainless Steel Mix Tanks
 - Capacities of 200 - 1750 gallons plus portable pilot tanks
 - Nitrogen inerted and jacketed with heating and cooling
 - Variable speed agitation with multiple blade types
- Particle dispersion via multiple high shear options
- Bulk solvent storage and DI water generation
- Recipe control and robust standard work
- Distributive control system with data historian



Solution Delivery

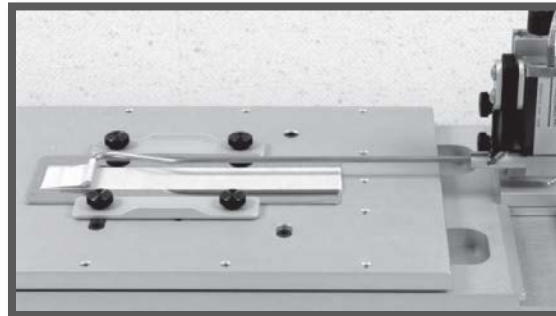
- Inline mixing and filtering
- Closed loop mass flow control
- Variety of pumping options
- De-bubbling
- Process verification (T, P, flow rate, level control, etc.)
- Overhead lines with filtration direct from solution making
- Pails, drums, or totes at the coating station for small volume experiments and production



Quality & Analytical Testing Capability

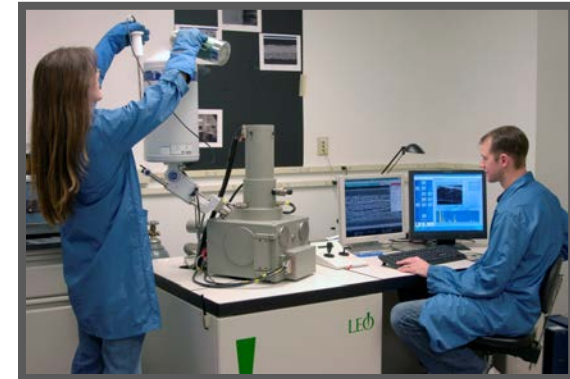
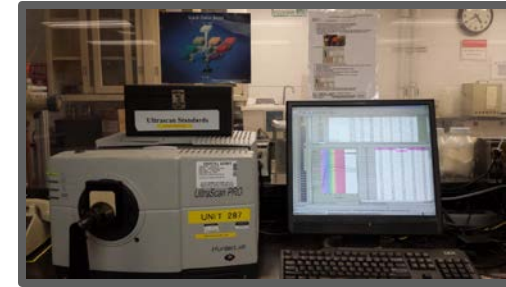
Test Equipment Includes

- Optical Microscopy
- Scanning Electron Microscope (with EDX)
- Atomic Force Microscopy (AFM)
- High Performance Liquid Chromatograph
- X-Ray Fluorescence Spectrometers
- Gas Chromatograph with Mass Spectrometer
- Thermogravimetric Analysis - Fourier Transform Infrared Spectrometer (TGA-FTIR)
- Optical Profilometry
- Inductively Coupled Plasma Spectrometer
- Dynamic Scanning Calorimetry
- Dynamic Mechanical Analysis
- Ultra-Violet / Visible Spectrometers
- Microtrac Particle Size Analyzer
- Microtome
- Titrations



Test Properties Include

- Thickness / Uniformity / Coat Weight
- Viscosity / Density / % Solids / Surface Tension
- Cosmetics (streaks, point defects, etc.)
- Peel force / Adhesion
- Retained solvents
- Porosity / Density
- Particle size
- Roughness
- Contact Angle
- Moisture analysis
- Conductivity / Resistivity



Carestream

Energy Storage Coatings and Technologies

info@tollcoating.com