

More accurate, non-contact in-line thickness measurement of architectural coatings and various industrial coatings



Novel In-line coating thickness measurement technology

Uses 'Ruggedized Optical Interference' (ROI) technique

Yields coating thickness or film weight results

Lab and In-line configurations – with OEM options

Measurement of single or multiple layers

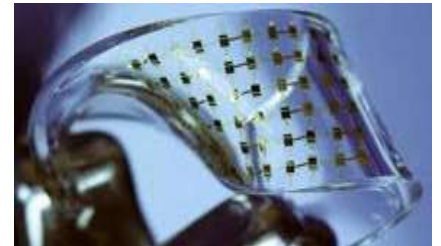
Flexible for use with various industrial applications

Recognized innovation award-winning technology:

EU: Metpack Gold Innovation Award

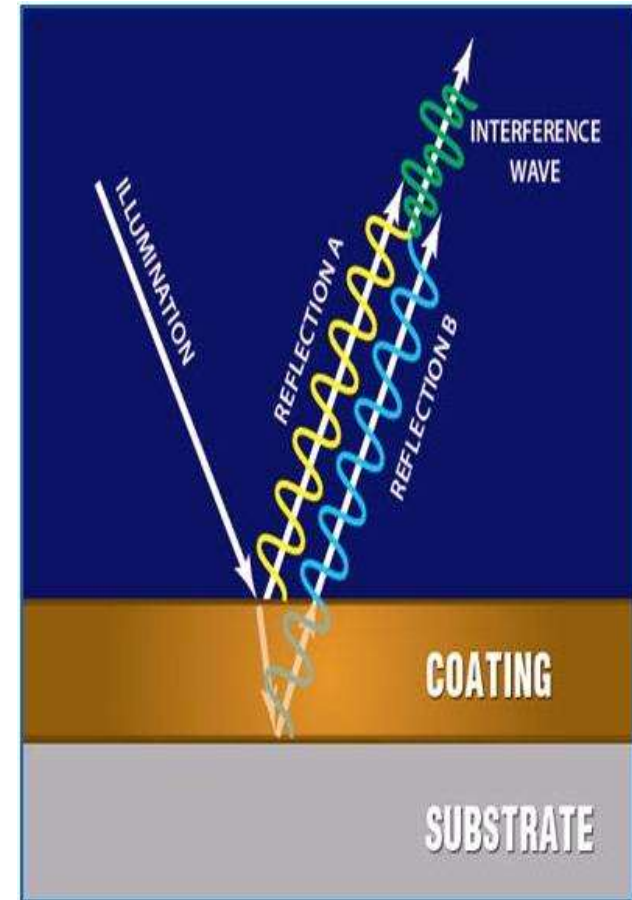
USA: AIMCAL Technology of Year

Asia: ICE Asia Innovation Award



Exclusive ROI & EXR Technologies

- Proprietary 'Ruggedized Optical Interference' (ROI) technology and 'Extended Range (EXR) Optical Interference' technologies
- Exclusive ability to measure wet/dry coatings and films while in-process
- Exclusive ability to measure wet/dry coatings and films while in-process
- Generates absolute thickness data
- Measures clear and opaque coatings
- Substrate Independent
- Measurement range:
 - ❖ Clear/Transparent: 0.2 to 350 microns
 - ❖ Pigmented: 0.7 to 75 microns



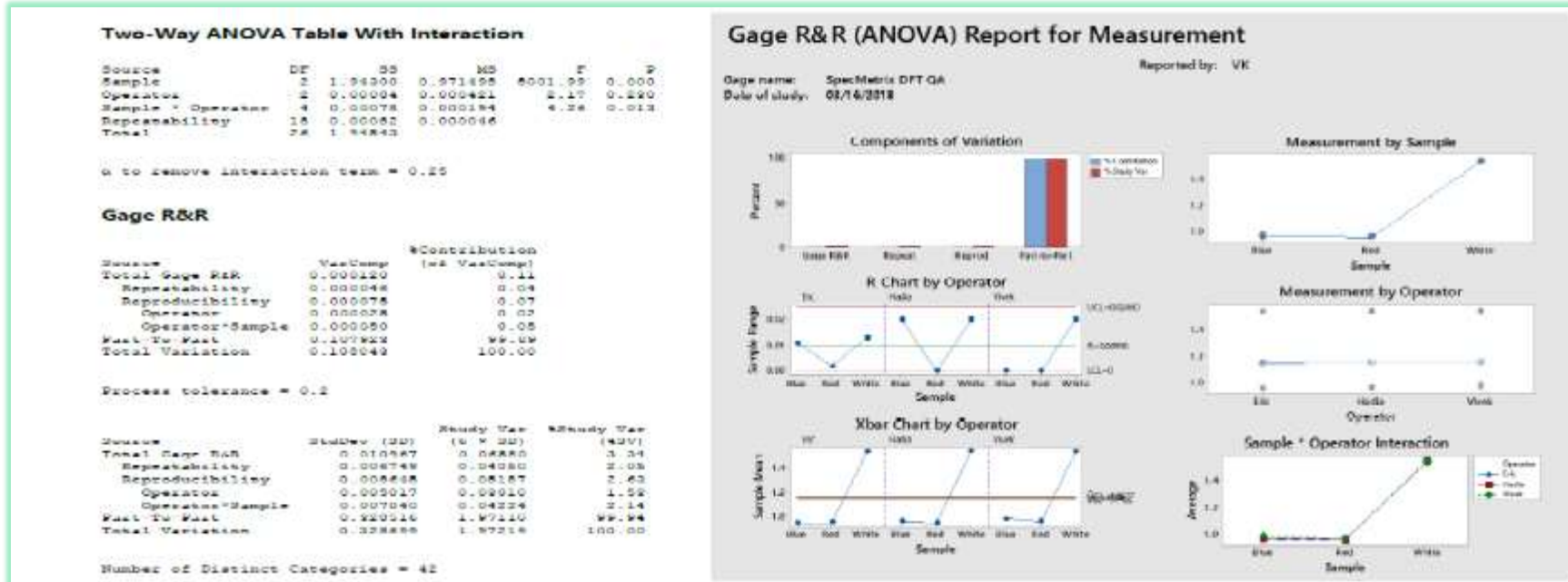
Technical Advantages: **ROI & EXR** technologies

- even pigmented/non-
- Measurement technique not dependent on paint color.
- -contact, non-destructive, and non-
-
- High speed measurements with 100+ measurements per second
- Absolute thickness measurements, with ___
-
-
- pigmented.



Gage R&R and Measurement Precision

ROI Technology- Superior Gage R&R Results



Overall Gage R&R on topcoat panels: 3.34%

Superior results on Inter-Laboratory Study (ILS)





Offline Measurements and Comparison

Range of Use: QA and In-process Applications

Corporate Teams

- QA Labs and sample testing
- Technical and R&D centers
- Pilot lines
- Coating supplier tech centers
- Film weight forensics/ Claim review

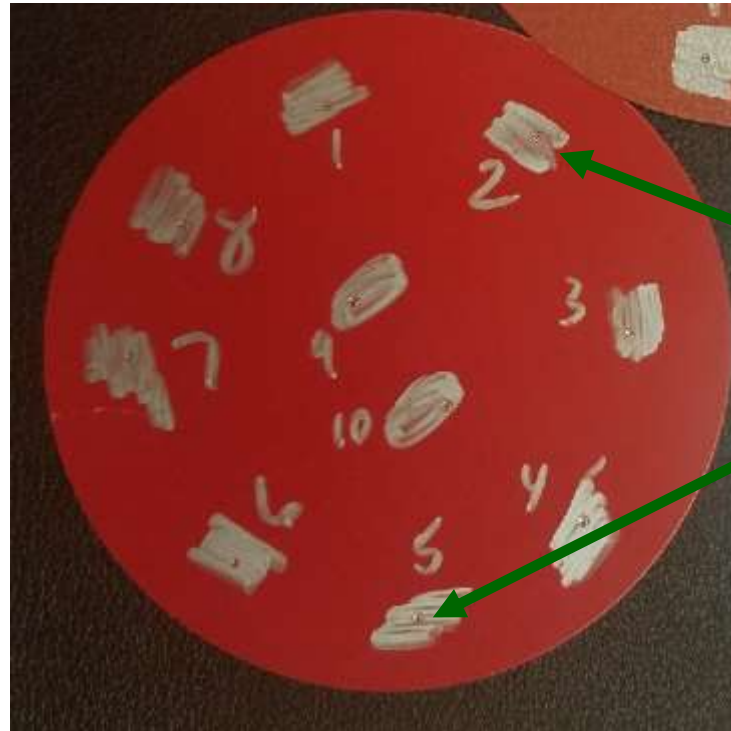
Manufacturing Plants

- Incoming coil inspection
- Coating and print lines
- Coil and component suppliers
- In-process coating measurements



Thickness Measurements w/Drill Methods

Drill Method	
	Thickness (mils)
1	0.95
2	0.97
3	0.95
4	0.90
5	0.88
6	0.96
7	0.91
8	0.91
9	0.88
10	0.94
Average	0.925
Variance	0.09



0.97 mil

0.88 mil


0.09 mil

Comparative DFT Measurement Results

Drill Method			
	Sample 1	Sample 2	Sample 3
1	1.02	0.95	0.81
2	0.96	0.97	0.77
3	1.02	0.95	0.81
4	0.99	0.90	0.81
5	1.01	0.88	0.79
6	1.02	0.96	0.79
7	0.98	0.91	0.83
8	0.97	0.91	0.81
9	1.01	0.88	0.84
10	1.03	0.94	0.85
Average	1.001	0.925	0.811
Variance	0.070	0.090	0.082

EXR			
	Sample 1	Sample 2	Sample 3
1	1.01	0.92	0.80
2	1.01	0.92	0.80
3	1.01	0.92	0.80
4	1.01	0.92	0.80
5	1.01	0.92	0.80
6	1.00	0.92	0.80
7	1.01	0.92	0.80
8	1.00	0.92	0.80
9	1.00	0.92	0.80
10	1.00	0.91	0.80
Average	1.005	0.918	0.803
Variance	0.010	0.004	0.005





Architectural and Industrial Coatings

Non-contact In-line **Primer & Backer** measurement

Sample	Primer on Coils	
	thickness(μ)	mils
1	6.65	0.26
2	6.61	0.26
3	6.35	0.25
4	6.25	0.25
5	6.54	0.26



- Online real-time measurement of primer on aluminum or steel coils
- Cost savings from minimizing QA time and over application of topcoats
- Avoiding under or over-application of primer coatings

Non-contact In-line **topcoat** measurement

Sample	TopCoat + Primer on Coils	
	thickness(μ)	mils
1	23.87	0.94
2	23.9	0.94
3	23.84	0.94
4	23.71	0.93
5	23.98	0.94



- Online measurement of various topcoats on aluminum or steel coils
- Cost savings from minimizing over application
- Quick changeover times



Thin Organic coatings (TOC)

Pre-Treatments

Permanent Coatings

Thin Organic Coatings

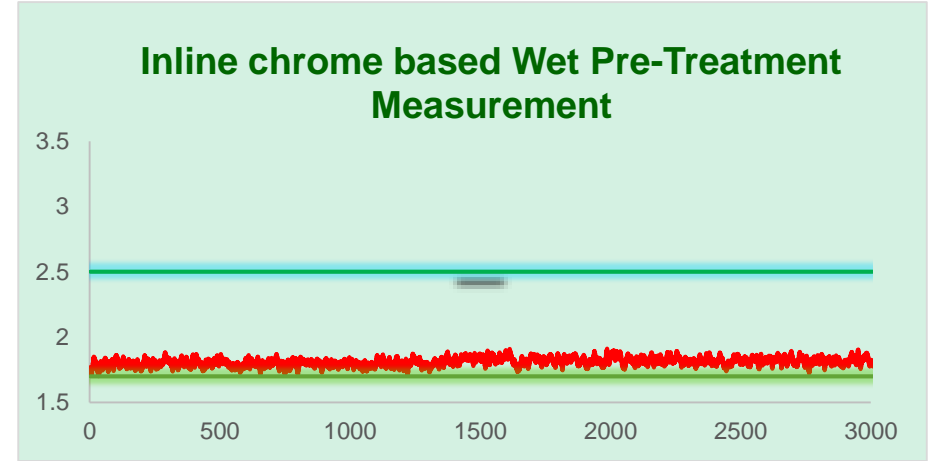
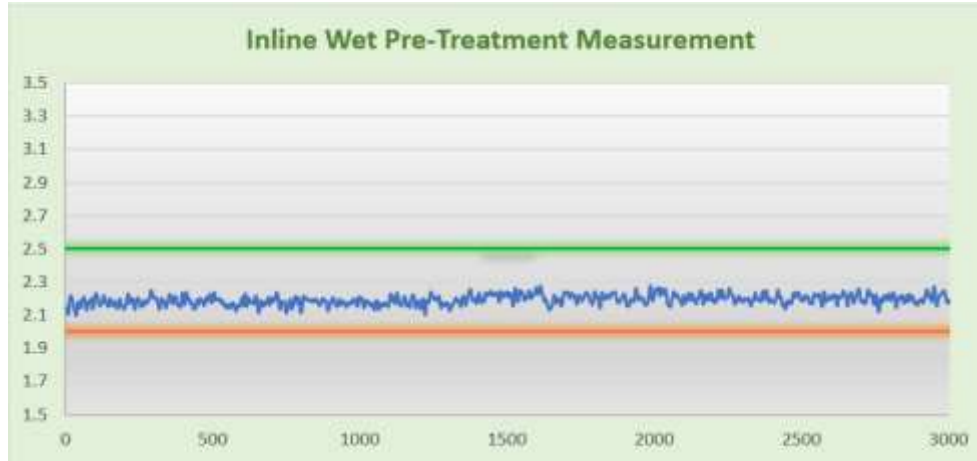
- There are numerous thin coatings used in coil coating, including:
 - ❖ Thin Organic Coatings
 - ❖ Pre-treatments
 - ❖ Permanent coatings
 - ❖ Dry Film Lube

- Current method of measurement are:
 - ❖ **Gravimetric**: Measuring coating weight by stripping coating – could be highly inaccurate for very thin coatings
 - ❖ **XRF**: Measures chemical content and not true thickness or coat weight

- ROI technology can be used to measure
 - ❖ **Dry** pre-treatments if greater than 1 micron (> 0.04 mils)
 - ❖ **Wet** pre-treatments



Wet chrome based and chrome-free pre-treatment measurement



- **Chrome-Free** pretreatment for Aluminum Can end stock
- **Chrome-based** pretreatment for Steel substrate
- Corrosion resistant pre-treatment
- Wet thickness around **2 microns (0.08 mils)**
- Dry thickness around **0.1 microns (0.004 mils)**
- Can be measured wet inline as its being applied
 - ❖ Assured presence of applied pre-treatment
 - ❖ Side to side consistency
 - ❖ Optimized control of wet pretreatment application
- Measurement does not depend on chemical content

TOC/Permanent Coating on AluZn and Aluminum substrate



Sample ID (AluZinc)	1 (μ)	2 (μ)	3 (μ)	4 (μ)	5 (μ)	AVG (μ)
114	2.24	2.3	1.88	1.82	2.17	2.08
96	1.85	1.86	1.67	1.84	1.82	1.81
70	1.38	1.57	1.59	1.39	1.58	1.50
60	1.18	1.18	1.28	1.22	1.22	1.22
40	0.88	0.84	0.84	0.87	0.84	0.85

Sample ID (Aluminum)	1 (μ)	2 (μ)	3 (μ)	4 (μ)	5 (μ)	AVG (μ)
114	2.09	2.28	2.33	2.03	2.31	2.21
96	1.92	1.95	2.013	2.15	1.94	1.99
70	1.89	1.68	1.73	1.72	1.93	1.79
60	1.37	1.31	1.39	1.43	1.33	1.37
40	1	0.99	0.99	1.01	1.01	1.00

- Excellent corrosion resistance.
- Sustainable surface treatment
- Corrosion resistant pre-treatment
- Provides excellent adhesion between paint and metal
- Provides versatility in application process
- Substrate type doesn't effect measurement

Laminated Steel for Packaging



<i>Description</i>	<i>PET</i>	<i>PP</i>
thickness (μ)		
<i>Area 1</i>	21.57	15.19
<i>Area 2</i>	20.64	14.97
<i>Area 3</i>	20.77	15.38
<i>Area 4</i>	20.93	15.46
<i>Area 5</i>	19.75	15.34
AVG.	20.73	15.27

- Laminated steel coil used for packaging applications
- No emission of VOCs (Volatile Organic Compounds)
- Sustainable Packaging
- Film thickness of applied PP, PET or other films is critical for proper functionality
- The film thickness can be measured real time after its laminated to steel substrate
- Adhesive thickness can also be measured on some laminated coils



Other Industrial Applications

Coatings on Glass



Measurement Position	1 (μ)	2 (μ)	3 (μ)	4 (μ)	5 (μ)	Average (μ)
B-1	32.39	32.55	32.56	32.17	32.29	32.39
B-2	30.56	30.06	30.12	30.49	30.11	30.27
B-3	18.34	18.12	18.21	18.33	18.4	18.28
B-4	23.97	23.78	23.7	23.6	23.61	23.73
1-3	29.06	29.69	29.39	29.32	29.82	29.46
1-6	39.53	39.34	40.53	41.69	41.79	40.58



- Mirror backing paints
- Solar Mirror applications
- Decorative Paints on Flat Glass
- Protective coatings on glass containers
- Coatings on glass applications for automotive.
- Paint on cell phone glass

Coatings on various substrates



- UV hard coats on solar window films
- UV coatings on printed metal and coil
- Solvent and water based Adhesives
- Clear coatings on Laminate floor
- Smart coatings such as hydrophobic coatings
- Battery Separator films



Technology Implementation and Benefits

Technology Implementation





Technology Benefits

Improved Quality and Consistency:

- Deliver consistent quality
- More efficient coating application
- Provide confidence that products will meet warranty requirements
- Retain historical measurement data that can be used to answer end-user questions or claims

Time Savings:

- Enables coil coaters to make adjustments in real time with minimal impact to production
- Minimizes or eliminates the need or number of test shots
- Better set up and change over times due to more precise historical data and faster response on current runs

Technology Implementation Benefits

Cost Savings:

- Ability to apply coating at lower end of specification due to continuous measurement data
- Reduction of non value-added waste streams
- Reduction in number of claims
- Increased throughput with shorter changeover times
 - ❖ Average setup time reduction from 7 minutes to about 45 seconds
 - ❖ Setup time varies by application and could be longer.

Process Optimization:

- Better Process Control
- Tighter standard deviation
- Reduction of defects related to film application (high film, low film, edge blisters, off color)
- Strong DFT reading repeatability across different lab operators
- Suitable for 'closing the loop' with automated real-time measurements



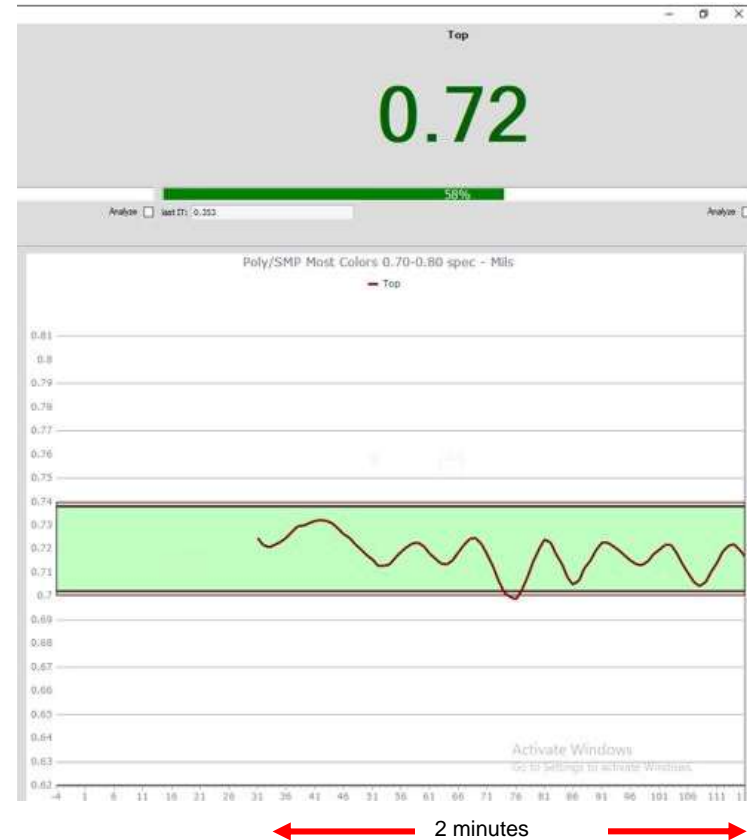
Process Improvements

Real-Time Adjustments to the Process

Fast adjustment of DFT during trial



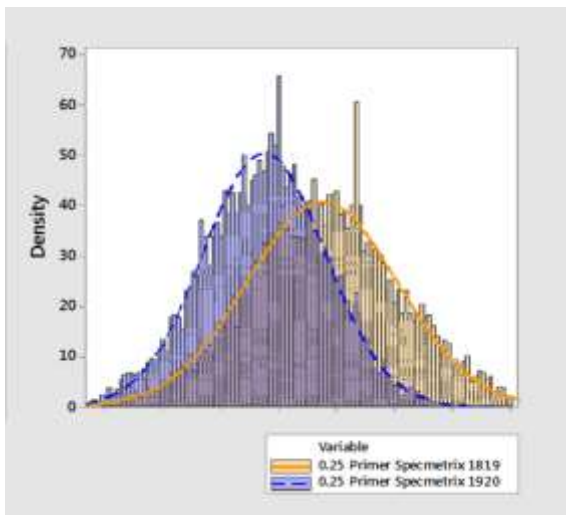
Stabilized DFT during production



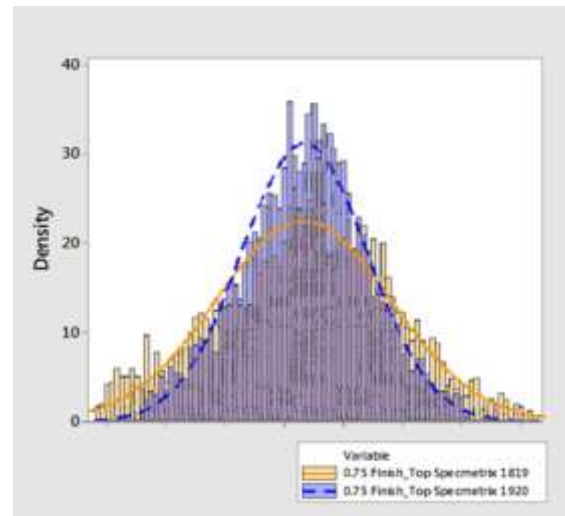
Process Control Improvements and cost savings

- First Step is CONTROL, tightened standard deviation
- Second Step is REDUCTION, lower the mean

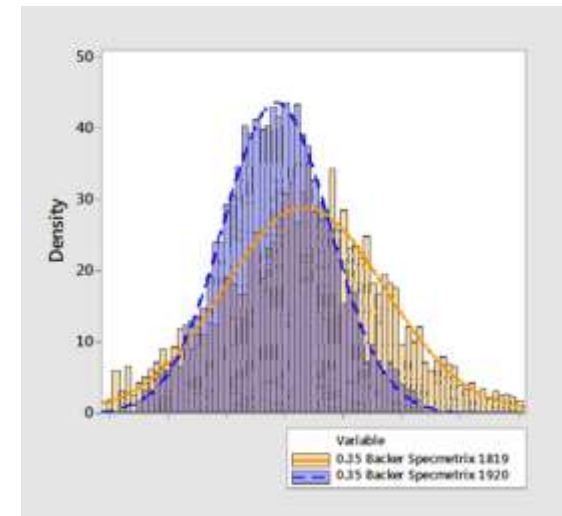
Primers



Finish Top



Backers



- With tightened control and consistency, it is possible to provide real time feedback to coater to achieve automated **closed loop control**



Summary and Opportunities

- ❖ Robust and accurate real-time absolute thickness measurements
- ❖ Provides e-record of web data from each run
- ❖ Recipe based software encourages adherence of operators
- ❖ Non-contact, non-destructive and low maintenance alternative
- ❖ Measures wet or dry and discrete layers, even in sub-micron range
- ❖ Better throughput, with no need to stop the production line for off-line testing
- ❖ Broad range of application usage
- ❖ Improve product quality, optimize process control and save costs at the same time
- ❖ Valuable high resolution real time data enabling key data driven decisions
- ❖ Ability to have closed loop application control.

For further information, please contact us at any time:

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