Sensory Analytics Recognized for

2021

Technology Innovation Leadership

North American Online Non-Contact
Coating Thickness Measurement Industry
Excellence in Best Practices

FROST *&* SULLIVAN

Best Practices Criteria for World-Class Performance

Frost & Sullivan applies a rigorous analytical process to evaluate multiple nominees for each Award category before determining the final Award recipient. The process involves a detailed evaluation of best practices criteria across two dimensions for each nominated company. Sensory Analytics excels in many of the criteria in the Online Non-Contact Coating Thickness Measurement space.

AWARD CRITERIA

Technology Leverage	Business Impact
Commitment to Innovation	Financial Performance
Commitment to Creativity	Customer Acquisition
Stage Gate Efficiency	Operational Efficiency
Commercialization Success	Growth Potential
Application Diversity	Human Capital

Real-time Sub-micron Thickness Measurement to Deliver Quality

Coatings are applied to metal coils, plastic films, laminates, and nonwovens in continuous web processes for functional properties and surface protection of the substrate material used in consumer product packaging, building materials, such as exterior metal cladding, appliances, house wraps, and Lithium-ion battery components, including separators and electrodes. Manufacturers are constantly looking for ways to improve coating quality by measuring the coating thickness and basis weight while reducing coating cost. In alignment with sustainable manufacturing objectives, Frost & Sullivan points out that stakeholders are prioritizing outcome improvement in three critical areas: material savings through reduced scrap and coating usage, increased yield of saleable product by improving machine utilization, and reduction in customer claims by improving overall product quality.

> *"Manufacturers are constantly looking for ways to improve coating quality by measuring the coating thickness and basis weight while reducing coating cost. With coatings becoming increasingly thin and applied within tight tolerance limits, the ability to measure accurate and precise uniform thickness during production allows manufacturers to capture in-process defects and eliminate product waste."*
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> **- Isaac Premsingh, Senior Consultant**

Web gauging platforms are key enablers that help web manufacturers deliver price-performance value to their customers. Consisting of a 3-part system that includes a sensor package, a scanner in O-frame, C-frame or box-beam frames, and a control system, web gauging systems are differentiated by the sensor

technology used - which is dependent on the type of material in the web.

Frost & Sullivan notes that the technology landscape for coating thickness measurement is competitive and mature. Infrared, nuclear, X-ray, optical, and terahertz are the main technology alternatives widely used in web gauging applications. Historically, nuclear gauges based on beta back-scattering or transmission have been dominant, mainly for plastic films and laminates processed in extrusion and converting lines. However, customers are increasingly requesting environment-friendly alternatives due to rising concerns over the use of nuclear sources and changing regulatory framework on their maintenance and use. In addition, the sources used in nuclear gauges deteriorate over time, mandating periodic replacement, which adds to operating costs.

The infrared (IR) absorption method is prevalent in clear coating lines supplying the packaging industry, where the coating weight and thickness is measured as a function of a specific chemical present in the coating. While IR absorption is less expensive than nuclear gauges, it is not preferred for opaque-coated surfaces and is being replaced by advanced optical techniques that are more accurate.

Frost & Sullivan analysts observe how the need for absolute thickness measurement systems with the ability to provide direct true thickness of the coating in real time is emerging. For instance, nuclear gauges measure the mass of the material substrate before and after it is coated to calculate the difference, which corresponds to the coating weight. Yet during mass difference calculation, it is quite difficult to identify the inconsistencies in thickness of the coating across the substrate surface. As coating materials vary in density, the conversion from measured mass to coating thickness is a cumbersome and complicated multi-step process that requires constant calibration to achieve accurate measurement. With coatings becoming increasingly thin and applied within tight tolerance limits, the ability to measure accurate and precise uniform thickness during production allows manufacturers to capture in-process defects and eliminate product waste.

Commitment to Innovation and Creativity

Founded in 2005 and headquartered in North Carolina, Sensory Analytics is an optical measurement technology company focused on delivering transformative online non-contact measurement solutions that have created new benchmarks in quality of coated webs and metal sheet products. Innovation is at the core of Sensory Analytics' value creation framework, with R&D taking the largest portion of total spend every year. With a focus on developing commercially viable technology solutions that meet unsolved industrial customer needs, Frost & Sullivan recognizes how the company has consistently created innovative products that are properly aligned with evolving trends in end-market segments.

In 2016, as a testament to its customer-centric innovation process, Sensory Analytics identified a gap in the market for a reliable in-process online non-contact thickness measurement of metal coil coatings through requests mainly from architectural metal cladding, roofing, HVAC, appliance, and Lithium-ion battery electrode manufacturers. Industrial customers working with metal were facing problems due to unreliable measurements on pigmented or opaque coatings using traditional methods such as standard modeling-based reflectometry methods while measuring thicknesses on moving substrates. Modeling-based reflectometry is suited only for static substrates, and their accuracy reduces at sub-micron thickness levels. Other alternative methods including capacitance and inductive methods are not

applicable for inline measurements on moving coil. Sensory Analytics solved this dual challenge by pushing the limits of conventional optical interference to create a new white space that has now become a standard in optical thickness measurement.

The core technology Ruggedized Optical Interference (ROI) is a patented and proprietary technique based on the science of optical interference. The principle of working involves a broadband light source used to illuminate coated surface and some portion of light reflects from the top and bottom interface of a layer of applied coating, creating an interference wave. The frequency of the interference wave is directly proportional to the coating layer thickness, which is calculated by proprietary SpecMetrix® algorithms to provide coating thickness measurement data as output. For wet coating systems, the software is programmed to account for solids content and coating density to convert measured wet thickness into dry coating weight. While other competing solutions based on optical interference do exist in the market today, Frost & Sullivan points out that SpecMetrix® is the only technology that can provide a substrate-agnostic direct absolute thickness and basis weight measurement solution for all wet and dry coatings - including pigments, varnish, and applied coatings of any color in continuous high-speed lines within its measurement range.

Application Diversity and Commercialization Success

SpecMetrix ROI technology systems are currently dominant in the North American metal packaging industry where flat sheets and coils used in making food and beverage containers are coated with high-performance barrier functional coatings. The unique value proposition offered by ROI in this application is its ability to measure thickness of in-process wet coatings. Competing techniques, including nuclear, cannot measure wet film thickness on moving substrate, and customers are unwilling to lose the 15 minutes of valuable production time for coating to be cured before identifying mismatches in thickness specifications. Metal coils used in home appliances and architectural façade panels for building exteriors and blinds is another segment where SpecMetrix® ROI technology has captured the leadership position. In the film packaging segment, SpecMetrix® is competing with nuclear gauges and IR absorption. As the largest and mature segment for web gauging technologies, Frost & Sullivan notes that flexible packaging of food and beverage presents a significant growth opportunity for SpecMetrix™, as use of online gauges in multi-layer coating and converting lines is quite critical to achieve uniform adhesion and lamination.

In addition, Sensory Analytics is also working closely with key stakeholders in consumer electronics and the Li-ion battery value chain to address gaps in the wet-film thickness measurement of electrode slurry coatings containing Lithium cobalt oxide, Lithium manganate oxide, or Lithium iron phosphate for positive electrodes, and a conductive carbon active agent for negative electrodes. The thickness of electrode coating has a direct impact on capacity, voltage, and rate characteristics of battery. Therefore, it is necessary to ensure a continuous coating of uniform thickness to achieve quality and safety standards. Existing nuclear, Near IR (NIR) absorption, and other optical methods are not suitable for opaque coatings on high-speed electrode and separator coating lines. Due to extremely stringent tolerance limits on thickness specifications at +/- 5% of 50 to 60 micron thickness ranges, electrode manufacturers are exploring new online measurement techniques with automatic gauge control to prevent defects and reduce waste. With only 20% of global separator and electrode coating lines currently using some form of online gauging and control system, SpecMetrix® has a significant growth

potential driven by its ability to provide real-time absolute wet coating thickness in the range of 0.2 to 350 microns for continuous processes on all types of metal and plastic substrates used in Lithium-ion batteries.

In the defense and space industry, as customers replace metal with composites to reduce weight, new challenges are created in thickness measurement. As a substrate, carbon fiber reinforced polymer (CFRP) composites absorb light and cannot be measured using optical methods. Sensory Analytics is working with leading aerospace customers to overcome this problem using SpecMetrix® technologies.

Stage-Gate Efficiency and Customer Acquisition

Web gauging systems are difficult to standardize and are often complex to configure and install. SpecMetrix® is transforming the space with its ruggedized coating measurement solutions that are highly customizable and certified to five global standards including ASTM, EX, CE, SA, and UL - making them virtually compatible with any manufacturing environment to provide actionable insights and continuous process control to improve coating quality with unprecedented accuracy. SpecMetrix technology is also offered under license as an OEM 'black box' option more suitable for in-process measurement of coated automotive and aerospace components with easy integration options suitable for robotic automation of thickness measurements.

Sensory Analytics offers turnkey online, non-contact gauging solutions that are designed, developed, and installed as complete systems at the coating lines of customers. To simplify the deployment process and enhance customer on-boarding experience, the company offers an add-on integration package that provides complete access to measured data directly to customer's central manufacturing execution systems. Sensory Analytics supports its global customer base from its expanding corporate office and technical center as well as through global industry partners. Realizing the value of real-time availability of critical resources, the company provides a comprehensive support service that includes different levels of engagement with customers, including data sharing, to enable new product development and a data-as-a-service model where it provides real-time support to customers on how to utilize generated data in effective decision making to achieve process improvement objectives at each coating line. This is aligned with the company's strategy to provide consultative services to customers while incorporating closed-loop control capabilities that essentially allow SpecMetrix® systems to provide real-time feedback to control systems engineers at the plant to optimize process parameters instantly to achieve productivity and outcome improvements related to coating quality and material savings.

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Sensory Analytics clearly realizes that customer readiness for automatic gauge control through integration of closed-loop systems in coating lines varies by industry in North America and globally. To improve ease of deployment for legacy systems, Sensory Analytics works collaboratively with the

management teams at customer locations to show proof-of-value and enable a mindset change toward acceleration of Industry 4.0 projects, thereby enhancing customer acquisition and retention.

Conclusion

Frost & Sullivan analysts conclude that Sensory Analytics' suite of real-time in-line non-contact measurement solutions consisting of its proprietary algorithms and 3-part gauging systems is well-positioned to address the existing and emerging challenges faced by customers in automotive, aerospace, military, space, battery, building materials, and packaging industries.

The patented Ruggedized Optical Interference (ROI) technology commercialized by Sensory Analytics has become the leader in coating thickness and basis weight measurement in multiple end markets, including metal coating lines processing flat sheets for metal packaging, metal coils coated for use in architectural building façade panels, and metal roofing. Playing in an extremely competitive and complex industry, Sensory Analytics has created a niche for itself, as SpecMetrix is the only technology that offers a substrate-agnostic direct absolute thickness and basis weight measurement solution for all kinds of wet and dry coatings of any color applied in continuous high-speed lines.

With its strong overall performance, Sensory Analytics earns the 2021 Frost & Sullivan Technology Innovation Leadership Award.

What You Need to Know about the Technology Innovation Leadership Recognition

Frost & Sullivan's Technology Innovation Award recognizes the company that has introduced the best underlying technology for achieving remarkable product and customer success while driving future business value.

Best Practices Award Analysis

For the Technology Innovation Leadership Award, Frost & Sullivan analysts independently evaluated the criteria listed below.

Technology Leverage

Commitment to Innovation: Continuous emerging technology adoption and creation enables new product development and enhances product performance

Commitment to Creativity: Company leverages technology advancements to push the limits of form and function in the pursuit of white space innovation

Stage Gate Efficiency: Technology adoption enhances the stage gate process for launching new products and solutions

Commercialization Success: Company displays a proven track record of taking new technologies to market with a high success rate

Application Diversity: Company develops and/or integrates technology that serves multiple applications and multiple environments

Business Impact

Financial Performance: Strong overall financial performance is achieved in terms of revenues, revenue growth, operating margin, and other key financial metrics

Customer Acquisition: Customer-facing processes support efficient and consistent new customer acquisition while enhancing customer retention

Operational Efficiency: Company staff performs assigned tasks productively, quickly, and to a high-quality standard

Growth Potential: Growth is fostered by a strong customer focus that strengthens the brand and reinforces customer loyalty

Human Capital: Commitment to quality and to customers characterize the company culture, which in turn enhances employee morale and retention

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About Frost & Sullivan

Frost & Sullivan is the Growth Pipeline Company™. We power our clients to a future shaped by growth. Our Growth Pipeline as a Service™ provides the CEO and the CEO's growth team with a continuous and rigorous platform of growth opportunities, ensuring long-term success. To achieve positive outcomes, our team leverages over 60 years of experience, coaching organizations of all types and sizes across 6 continents with our proven best practices. To power your Growth Pipeline future, visit Frost & Sullivan at http://www.frost.com.

The Growth Pipeline Engine™

Frost & Sullivan's proprietary model to systematically create on-going growth opportunities and strategies for our clients is fuelled by the Innovation Generator™. Learn more.

Key Impacts:

- **Growth Pipeline:** *Continuous flow of Growth opportunities*
- **Growth Strategies:** *Proven Best Practices*
- **Innovation Culture:** *Optimized Customer Experience*
- **ROI & Margin:** *Implementation Excellence*
- **Transformational Growth:** *Industry Leadership*

The Innovation Generator™

Our six analytical perspectives are crucial in capturing the broadest range of innovative growth opportunities, most of which occur at the points of these perspectives.

Analytical Perspectives:

- Mega Trend (MT)
- Business Model (BM)
- Technology (TE)
- Industries (IN)
- Customer (CU)
- Geographies (GE)