

FROST & SULLIVAN

BEST PRACTICES

AWARDS

FROST & SULLIVAN

2020 BEST PRACTICES AWARD



**2020 NORTH AMERICAN
ANTI-FINGERPRINT COATINGS FOR ELECTRONICS
NEW PRODUCT INNOVATION AWARD**

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Background and Company Performance

Industry Challenges

Continuous research has been conducted for the commercialization of anti-fingerprint coatings; however, adoption has been hindered because of the inability of these coatings to resist oil produced by sebum. Currently available oleophobic coatings prevent the formation of fingerprints but cannot prevent their appearance on surfaces because of the difference between the refractive indices of each user's fingerprints and the device's display. Moreover, widely used oleophobic coatings cannot easily bond on all types of display surfaces because of the coatings' high surface energy, which drastically reduces the number of potential materials that can be used for developing protective coatings.

Many companies, therefore, are focused on developing a fingerprint-resistant coating that can be applied to various displays without compromising on performance; however, conventional coating techniques that are used for protective coatings are too complex for scale up when used for anti-fingerprint coatings. Companies, therefore, that want to offer anti-fingerprint coatings should develop a coating solution that meets the performance requirements; is suitable for use in various displays, irrespective of the materials used; and can be easily coated to the targeted substrates (displays).

New Product Attributes and Customer Impact

Boston-based NBD Nanotechnology Inc. (nbd nano) has successfully developed an anti-fingerprint coating called Invisiprint®. Based on Frost & Sullivan analysis, Invisiprint successfully addresses the challenges faces by currently available anti-fingerprint coatings, and the company has a significant first-mover advantage in the North American market.

Match to Needs

nbd nano's Invisiprint coating has high adoption potential because of its ability to improve the resistance against smudges on the device's display. Invisiprint holds an operational edge over available oleophobic coatings because it provides a lower angle of contact, which makes any smudges or fingerprints invisible. To attain this unique characteristic, nbd nano conducted a rigorous analysis on the composition and cause of fingerprints, such as water, amino acid, urea, ammonia secreted by sweat and triglycerides, fatty acids, squalene, and monoglycerides, all of which are secreted by sebum. The research conducted helped the company develop coating materials that are resistant to sebum and sweat. Competing anti-fingerprint coatings are not resistant to both of these components, leading to the formation of fingerprint images onto the device's display over prolonged use.

Frost & Sullivan analysis shows that nbd nano's Invisiprint can resist almost all factors that cause fingerprints, compared to other competing solutions in the North American market.

Reliability

nbid nano conducted studies using Invisiprint under various conditions, in terms of how its anti-fingerprint coating improves the life of the substrate on which it is applied (e.g., electronic displays). The material analysis showed that Invisiprint had a drop of only 15 degrees in the contact angle after 5,000 cycles of operation, compared to competing anti-fingerprint coatings that have a contact angle drop as high as 40 degrees, making competing coatings ineffective for use in displays and electronic devices. Moreover, Invisiprint has a low color difference factor Delta E (dE) compared to competing anti-fingerprint coatings. The broad range of operability and low fingerprint visibility are Invisiprint's key differentiating factors that have allowed it to gain a competitive position against other coatings.

Quality

nbid nano's Invisiprint coating has a low fingerprint visibility and high cleanability that is at least 10 times better than a normal anti-fingerprint coating, attributed to the low angle of contact that significantly reduces the wetting property. As a result, the fingerprint remains completely invisible, unlike with competing products that cause haze from transmitted light and reflects ambient light, thus making fingerprints visible.

Invisiprint is less toxic than competing products because its composition is fluorine free, which provides the company with a regulatory edge over competitors in North America. Frost & Sullivan analysis on various anti-fingerprint protection coatings reveals that Invisiprint holds several desirable parameters, such as clearability and low contact angle, allowing nbid nano to cater to both current and future applications in the electronics industry.

Positioning

nbid nano has positioned Invisiprint as an anti-fingerprint coating that is more oleophilic and less oleophobic than competing anti-fingerprint coatings. This categorization has allowed the company to tap into the electronics display market, which is growing at a rapid pace because of the increasing adoption of wearables and portable devices.

Moreover, with the launch of Invisiprint in 2017 in the United States, nbid nano now has a market edge in North America, attributed to the high traction of digital-enabling technologies, such as virtual reality, augmented reality, and smart homes. The high level of digital penetration, in tandem with the increased adoption of display materials, has made nbid nano's Invisiprint a truly disruptive solution.

Design

The manufacturing of nbid nano's Invisiprint coating comprises pre-treatment, coating, and baking. The substrate is first cleaned with plasma to maintain a contact angle of less than 10 degrees, and the coating is then applied through an atomized spray and baked at 150 degrees Celsius for 40 minutes. This procedure provides Invisiprint with a smooth finish, compared to currently available anti-fingerprint coatings. The anti-fingerprinting

performance is observed to surpass coating standards of the commonly used physical vapor deposition technique.

The durability of the Invisiprint coating is one of the primary factors driving its adoption because it is twice as durable as leading anti-fingerprint solutions available in the market. For example, Invisiprint has a dE value as low as 0.25, compared to the 2.65 (the average of 3M, Dow, and Daikin) of competing solutions. Moreover, nbd nano's enhanced manufacturing procedure significantly improves the texture and finish of the Invisiprint coating, making it ideal for adoption in a broad spectrum of applications, such as electronic displays and automotive windshields.

Customer Purchase Experience

With the distinct market position of Invisiprint, nbd nano has successfully attracted several global display screen participants, such as US-based ZAGG Inc, which signed a three-year contract with nbd nano. As a part of this agreement, ZAGG has coated more than 10 million protective glasses with Invisiprint to increase the performance benefits of its products. NBD replaced incumbent market leaders in the Anti-Fingerprint space with Zagg and Invisiprint's global reach is expected to increase significantly based on ZAGG's large global market share (20% as disclosed by nbd nano).

With its unique manufacturing technique, Invisiprint has proved to be more effective than anti-fingerprint coatings that use a physical vapor deposition technique adopted by competitors, resulting in the large-volume manufacturing of high-grade coatings (e.g., low visibility and high clearability). In addition, nbd nano is working with leading OEMs in the consumer electronics space. The large-volume production capacity of Invisiprint and its seamless uniform property can help NBD gain more interest in the consumer electronics industry.

Based on Frost & Sullivan research, nbd nano's collaboration with major consumer electronics and screen protection manufacturers has placed Invisiprint as a benchmark solution in the anti-fingerprint coatings market.

Conclusion

The demand for an anti-fingerprint coating that is more oleophilic and less oleophobic is significantly increasing.

nbd nano has successfully met this market demand through its Invisiprint solution, which is durable and has a low dE value. Invisiprint's performance has surpassed that of competing solutions, allowing nbd nano to enter into partnership deals with noteworthy consumer electronics companies. The company has gained visibility among both display and device manufacturers through its unique design of Invisiprint, including improved clearability and reduced fingerprint visibility, which are critical factors for creating an appealing display.

For its strong overall performance, NBD Nanotechnology has earned Frost & Sullivan's 2020 New Product Innovation Award for anti-fingerprint coatings in the North American electronics industry.

Significance of New Product Innovation

Ultimately, growth in any organization depends on continually introducing new products to the market and successfully commercializing those products. For these dual goals to occur, a company must be best in class in three key areas: understanding demand, nurturing the brand, and differentiating from the competition.



Understanding New Product Innovation

Innovation is about finding a productive outlet for creativity—for consistently translating ideas into high-quality products that have a profound impact on the customer.

Key Benchmarking Criteria

For the New Product Innovation Award, Frost & Sullivan analysts independently evaluated 2 key factors—New Product Attributes and Customer Impact—according to the criteria identified below.

New Product Attributes

- Criterion 1: Match to Needs
- Criterion 2: Reliability
- Criterion 3: Quality
- Criterion 4: Positioning
- Criterion 5: Design

Customer Impact

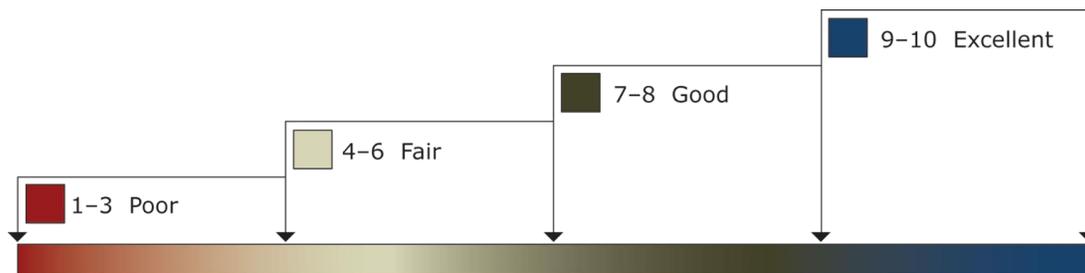
- Criterion 1: Price/Performance Value
- Criterion 2: Customer Purchase Experience
- Criterion 3: Customer Ownership Experience
- Criterion 4: Customer Service Experience
- Criterion 5: Brand Equity

Best Practices Award Analysis for NBD Nano

Decision Support Scorecard

To support its evaluation of best practices across multiple business performance categories, Frost & Sullivan employs a customized Decision Support Scorecard. This tool allows research and consulting teams to objectively analyze performance according to the key benchmarking criteria listed in the previous section, and to assign ratings on that basis. The tool follows a 10-point scale that allows for nuances in performance evaluation. Ratings guidelines are illustrated below.

RATINGS GUIDELINES



The Decision Support Scorecard considers New Product Attributes and Customer Impact (i.e., the overarching categories for all 10 benchmarking criteria; the definitions for each criterion are provided beneath the scorecard). The research team confirms the veracity of this weighted scorecard through sensitivity analysis, which confirms that small changes to the ratings for a specific criterion do not lead to a significant change in the overall relative rankings of the companies.

The results of this analysis are shown below. To remain unbiased and to protect the interests of all organizations reviewed, Frost & Sullivan has chosen to refer to the other key participants as Competitor 1 and Competitor 2.

<i>Measurement of 1-10 (1 = poor; 10 = excellent)</i>			
New Product Innovation	New Product Attributes	Customer Impact	Average Rating
NBD nano	9	9.5	9.25
Competitor 1	9	9	9
Competitor 2	8	9	8.25

New Product Attributes

Criterion 1: Match to Needs

Requirement: Customer needs directly influence and inspire the product’s design and positioning.

Criterion 2: Reliability

Requirement: The product consistently meets or exceeds customer expectations for consistent performance during its entire life cycle.

Criterion 3: Quality

Requirement: Product offers best-in-class quality, with a full complement of features and functionalities.

Criterion 4: Positioning

Requirement: The product serves a unique, unmet need that competitors cannot easily replicate.

Criterion 5: Design

Requirement: The product features an innovative design, enhancing both visual appeal and ease of use.

Customer Impact

Criterion 1: Price/Performance Value

Requirement: Products or services offer the best value for the price, compared to similar offerings in the market.

Criterion 2: Customer Purchase Experience

Requirement: Customers feel they are buying the optimal solution that addresses both their unique needs and their unique constraints.

Criterion 3: Customer Ownership Experience

Requirement: Customers are proud to own the company’s product or service and have a positive experience throughout the life of the product or service.

Best Practices Recognition: 10 Steps to Researching, Identifying, and Recognizing Best Practices

Frost & Sullivan analysts follow a 10-step process to evaluate award candidates and assess their fit with select best practices criteria. The reputation and integrity of the awards are based on close adherence to this process.

STEP	OBJECTIVE	KEY ACTIVITIES	OUTPUT
1 Monitor, target, and screen	Identify award recipient candidates from around the world	<ul style="list-style-type: none"> • Conduct in-depth industry research • Identify emerging industries • Scan multiple regions 	Pipeline of candidates that potentially meet all best practices criteria
2 Perform 360-degree research	Perform comprehensive, 360-degree research on all candidates in the pipeline	<ul style="list-style-type: none"> • Interview thought leaders and industry practitioners • Assess candidates' fit with best practices criteria • Rank all candidates 	Matrix positioning of all candidates' performance relative to one another
3 Invite thought leadership in best practices	Perform in-depth examination of all candidates	<ul style="list-style-type: none"> • Confirm best practices criteria • Examine eligibility of all candidates • Identify any information gaps 	Detailed profiles of all ranked candidates
4 Initiate research director review	Conduct an unbiased evaluation of all candidate profiles	<ul style="list-style-type: none"> • Brainstorm ranking options • Invite multiple perspectives on candidates' performance • Update candidate profiles 	Final prioritization of all eligible candidates and companion best practices positioning paper
5 Assemble panel of industry experts	Present findings to an expert panel of industry thought leaders	<ul style="list-style-type: none"> • Share findings • Strengthen cases for candidate eligibility • Prioritize candidates 	Refined list of prioritized award candidates
6 Conduct global industry review	Build consensus on award candidates' eligibility	<ul style="list-style-type: none"> • Hold global team meeting to review all candidates • Pressure-test fit with criteria • Confirm inclusion of all eligible candidates 	Final list of eligible award candidates, representing success stories worldwide
7 Perform quality check	Develop official award consideration materials	<ul style="list-style-type: none"> • Perform final performance benchmarking activities • Write nominations • Perform quality review 	High-quality, accurate, and creative presentation of nominees' successes
8 Reconnect with panel of industry experts	Finalize the selection of the best practices award recipient	<ul style="list-style-type: none"> • Review analysis with panel • Build consensus • Select recipient 	Decision on which company performs best against all best practices criteria
9 Communicate recognition	Inform award recipient of recognition	<ul style="list-style-type: none"> • Inspire the organization for continued success • Celebrate the recipient's performance 	Announcement of award and plan for how recipient can use the award to enhance the brand
10 Take strategic action	Upon licensing, company is able to share award news with stakeholders and customers	<ul style="list-style-type: none"> • Coordinate media outreach • Design a marketing plan • Assess award's role in strategic planning 	Widespread awareness of recipient's award status among investors, media personnel, and employees

The Intersection between 360-Degree Research and Best Practices Awards

Research Methodology

Frost & Sullivan's 360-degree research methodology represents the analytical rigor of the research process. It offers a 360-degree view of industry challenges, trends, and issues by integrating all 7 of Frost & Sullivan's research methodologies. Too often companies make important growth decisions based on a narrow understanding of their environment, resulting in errors of both omission and commission. Successful growth strategies are founded on a thorough understanding of market, technical, economic, financial, customer, best practices, and demographic analyses. The integration of these research disciplines into the 360-degree research methodology provides an evaluation platform for benchmarking industry participants and for identifying those performing at best-in-class levels.



About Frost & Sullivan

Frost & Sullivan, the Growth Partnership Company, helps clients accelerate growth and achieve best-in-class positions in growth, innovation, and leadership. The company's Growth Partnership Service provides the CEO and the CEO's growth team with disciplined research and best practices models to drive the generation, evaluation, and implementation of powerful growth strategies. Frost & Sullivan leverages nearly 60 years of experience in partnering with Global 1000 companies, emerging businesses, and the investment community from 45 offices on 6 continents. To join Frost & Sullivan's Growth Partnership, visit <http://www.frost.com>.