RESEARCH FRONTIERS INC
Form 10-K
March 14, 2019

UNITED STATES

SECURITIES AND EXCHANGE COMMISSION

WASHINGTON, D.C. 20549

FORM 10-K

ANNUAL REPORT PURSUANT TO SECTION 13 or 15(d) of

THE SECURITIES AND EXCHANGE ACT OF 1934

For the fiscal year ended December 31, 2018 Commission File Number 000-14893

RESEARCH FRONTIERS INCORPORATED

(Exact name of registrant as specified in its charter)

DELAWARE	11-2103466
(State or other jurisdiction of incorporation or organization)	(I.R.S. Employer Identification No.)

240 CROSSWAYS PARK DRIVE	
WOODBURY, NEW YORK	11797-2033
(Address of principal executive offices)	(Zip Code)

Registrant’s telephone number, including area code (516) 364-1902

Securities registered pursuant to Section 12(b) of the Act:	Name of Exchange on Which Registered
Title of Class	
Common Stock, $0.0001 Par Value	The NASDAQ Stock Market

Securities registered pursuant to Section 12(g) of the Act: None

Indicate by check mark if the registrant is a well-known seasoned issuer, as defined in Rule 405 of the Securities Act.

Yes [ ] No [X]

Indicate by check mark if the registrant is not required to file reports pursuant to Section 13 or Section 15(d) of the Act. Yes [ ] No [X]

Indicate by check mark whether the registrant (1) has filed all reports required to be filed by Section 13 or 15(d) of the Securities Exchange Act of 1934 during the preceding 12 months (or for such shorter period that the registrant was required to file such reports), and (2) has been subject to such filing requirements for the past 90 days. Yes [X] No [ ]

Indicate by check mark whether the registrant has submitted electronically and posted on its corporate Web site, if any, every Interactive Data File required to be submitted and posted pursuant to Rule 405 of Regulation S-T (§ 232.405 of this chapter) during the preceding 12 months (or for such shorter period that the registrant was required to submit and post such files). Yes [X] No [ ]

Indicate by check mark if disclosure of delinquent filers pursuant to Item 405 of Regulation S-K is not contained herein, and will not be contained, to the best of registrant’s knowledge, in definitive proxy or information statements incorporated by reference in Part III of this Form 10-K or any amendment to this Form 10-K. [X]

Indicate by check mark whether the registrant is a large accelerated filer, an accelerated filer, a non-accelerated filer, smaller reporting company or an emerging growth company. See the definitions of “large accelerated filer,” “accelerated filer,” “smaller reporting company” and “emerging growth company” in Rule 12b-2 of the Exchange Act. (Check one):

Large accelerated filer [ ] Accelerated filer [ ] Non-accelerated filer [ ]

Smaller reporting company [X] Emerging growth company [ ]

If an emerging growth company, indicate by check mark if the registrant has elected not to use the extended transition period for complying with any new or revised financial accounting standards provided pursuant to Section 13(a) of the Exchange Act. [ ]

Indicate by check mark whether the registrant is a shell company (as defined in Rule 12b-2 of the Act).
Yes [ ] No [X]

The aggregate market value of the voting and non-voting common equity held by non-affiliates of the registrant as of June 30, 2018 (the last business day of the registrant's most recently completed second fiscal quarter), computed based on the closing sale price of $0.82 was $15,329,487. In making this computation, all direct and indirect shares known to be owned by directors and executive officers of the Company and all direct and indirect shares known to be owned by other persons holding in excess of 5% of the Company's common stock have been deemed held by "affiliates" of the Company, and awards of restricted stock subject to vesting are assumed to have been fully issued and outstanding. Nothing herein shall prejudice the right of the Company or any such person to deny that any such director, executive officer, or stockholder is an "affiliate."

On March 13, 2019, the registrant had 28,666,831 shares of Common Stock outstanding.

PART I

ITEM 1. BUSINESS

Forward-Looking Statements

Information included in this Annual Report on Form 10-K may contain forward-looking statements within the meaning of the Private Securities Litigation Reform Act of 1995. Forward-looking statements are not statements of historical facts, but rather reflect our current expectations concerning future events and results. We generally use the words "believes," "expects," "intends," "plans," "anticipates," "likely," "will" and similar expressions to identify forward-looking statements. Such forward-looking statements, including those concerning our expectations, involve risks, uncertainties and other factors, some of which are beyond our control, which may cause our actual results, performance or achievements, or industry results, to be materially different from any future results, performance or achievements expressed or implied by such forward-looking statements. These risks, uncertainties and factors include, but are not limited to, those factors set forth in this Annual Report on Form 10-K under "Item 1A. – Risk Factors" below. Except as required by applicable law, including the securities laws of the United States, we undertake no obligation to publicly update or revise any forward-looking statements, whether as a result of new information, future events or otherwise. You are cautioned not to unduly rely on such forward-looking statements when evaluating the information presented in this Annual Report on Form 10-K.

General:

As used herein, "we," "us," "our," the "Company" or "Research Frontiers" means Research Frontiers Incorporated unless otherwise indicated. Research Frontiers operates in a single business segment which is engaged in the development and marketing of technology and devices to control the flow of light (see Note 1). We develop and license our patented suspended particle device ("SPD-Smart") light-control technology to other companies that manufacture and/or market the: (i) SPD-Smart chemical emulsion, (ii) light-control film made from the chemical emulsion, (iii) the light-control panels made by laminating the film, (iv) electronics to power end-products incorporating the film, or (v) lamination services for, and the end-products themselves such as "smart" windows, skylights and sunroofs. Research Frontiers currently has over 40 companies that, in the aggregate, are licensed to primarily serve four major SPD-Smart application areas (aerospace, architectural, automotive and marine products) in every country of the world. In addition, in 2013 we launched our VariGuard business unit that markets and sells SPD-Smart products directly to customers for specialty uses such as the protection of artwork and light-sensitive documents in museums and private collections.

The Company has entered into a number of license agreements covering its light control technology. During 2018, four licensees accounted for 35%, 13%, 11% and 10%, respectively, of fee income recognized for the year. During 2017, four licensees accounted for 35%, 15%, 10% and 9%, respectively, of fee income recognized during the year. During 2016 four licensees accounted for 30%, 27%, 15% and 7%, respectively, of fee income recognized for the year.

Research Frontiers was incorporated in New York in 1965 to continue early work that Dr. Edwin Land, founder of Polaroid Corporation, and others had done in the area of light-control beginning in the 1930s. Research Frontiers was reincorporated in Delaware in 1989. Since 1965, Research Frontiers has actively worked to develop and license its own SPD technology, which it protects using patents, trade secrets and know-how. Although patent and trade secret protection is not a guarantee of commercial success, Research Frontiers currently has 226 patents that have been issued worldwide. In addition, the Company has current patent applications in the US and other countries that if granted, would add a significant number of additional patents to its portfolio. The Company has and continues to devote significant resources to develop, license and protect its intellectual property position.

SPD-Smart products use microscopic light-absorbing nanoparticles that are typically suspended in a film. These particles align when an electrical voltage is applied, thus permitting light to pass through the film. Adjustment of the voltage to the SPD film gives users the ability to quickly, precisely and consistently regulate the amount of light, glare and heat passing through the window, skylight, sunroof, window shade or other SPD-Smart end-product. This SPD film can be incorporated between two layers of glass or plastic, or combinations of both, to produce a laminate that has enhanced energy efficiency, light-control and security performance properties.

Research Frontiers believes that the SPD industry is in the initial phase of growth. SPD light-control technology may have commercial applicability in many products where variable light-control is desired. Some existing product applications for SPD-Smart glass or plastic include the following:

Automotive:
sunroofs, sunvisors, side windows and rear windows;

Aerospace and marine:
windows, doors, partitions, sunvisors, and skylights.

Architectural:
commercial and residential windows, doors, skylights, and partitions for new construction, replacement, and retrofit applications;

In addition to the product applications listed above, SPD-SmartGlass technology may also offer potential benefits in the development of new flat panel displays, light conservation panels, neonatal incubators, consumer electronics, eyewear, self-dimming automotive rear-view mirrors and other reflective information displays. However, such products need additional product design, engineering or testing before the commercial potential of such SPD-SmartGlass products can be determined.

Some of our licensees consider the stage of development, product introduction strategies and timetables, and other plans to be proprietary or secret. Unless required to disclose such information, the Company may limit its disclosure of licensees' activities until such licensees, or their customers, make their own public announcements of planned or actual product launches.

Some of the early sales and uses of SPD technology were to low volume commercial installations and some have involved concept and test installations by licensees and their customers. Recent progress with regard to market development and commercialization activity has been the result of focused and active efforts by Research Frontiers and its key licensees who have invested in product development and improvements, production facilities, increased production capacity, durability, performance testing, quality control and assurance, and marketing programs.

Beginning in late 2011, higher volume sales of SPD products commenced with the launch by Daimler AG of the Magic Sky Control™ all glass roof option on their Mercedes-Benz SLK (subsequently renamed SLC). In early 2012, sales of the Magic Sky Control™ all glass roof option commenced on their Mercedes-Benz SL. In mid-2014, sales of the Magic Sky Control™ all glass roof option commenced on the new S-Class Coupe with other Mercedes-Benz S-Class variants began offering the Magic Sky Control™ all glass roof option in 2015 and 2016.

Research Frontiers believes that with the normal progression of product and manufacturing improvements, and as licensees become more experienced at the lamination, fabrication and installation of SPD-Smart products for various applications, the adoption rates for SPD-Smart products will grow and accelerate, which we expect will increase the stream of royalty income for the Company. Research Frontiers believes the largest and most predictable near and intermediate term market for its technology will be automotive glass.

As part of their marketing and branding programs, many of our licensees have developed their own trademarks for SPD-Smart emulsion, film, and end-products and these are listed in their respective press releases, product brochures, advertising and other promotional materials. Research Frontiers uses the following trademarks: SPD-Smart™, SPD-SmartGlass™, VaryFast™, SPD-CleanTech™, SPD Clean Technology™, SmartGlass™, The View of the Future - Everywhere you Look™, Powered by SPD™, Powered by SPD-CleanTech™, Powered by SPD Clean Technology™, SG Enabled™, SPD Green and Clean™, SPD On-Board™, Speed Matters™, VariGuard™, VariGuard SmartGlass™ and Visit SmartGlass.com - to change your view of the world™.

In each of the last three fiscal years the Company devoted substantially all of its time to the development of one class of products, namely SPD-Smart light-control technology, and therefore revenue analysis by class is not provided herein. Information about our operations and those of our licensees is included below and in our financial statements and notes thereto.

The Company does not believe that future sales will be seasonal in any material respect. The Company does not currently directly manufacture products on its own but rather depends on activities of its licensees and vendors. Due to the nature of the Company’s business operations and the fact that the Company is not presently a manufacturer, there is no backlog of orders for the Company’s products.

The Company believes that compliance with federal, state and local provisions which have been enacted or adopted regulating the discharge of materials into the environment, or otherwise relating to the protection of the environment, will not have a material effect upon the capital expenditures, earnings and competitive position of the Company. The Company has no material capital expenditures for environmental control facilities planned for the remainder of its current fiscal year or its next succeeding fiscal year.

Employees:

On March 13, 2019, the Company had nine full-time employees, three of whom are technical personnel, and the rest of whom perform legal, finance, marketing, investor relations, and administrative functions. Of these employees, two have obtained doctorates in chemistry, one has a master's degree in chemistry, and one has extensive industrial experience in electronics and electrical engineering. Two employees also have additional postgraduate degrees in business administration, and one has a doctorate in jurisprudence. Also, the Company's suppliers and licensees have people on their teams with advanced degrees in a number of areas relevant to the commercial development of products using the Company's technology. The success of the Company is dependent upon, among other things, the services of its senior management, the loss of which could have a material adverse effect upon the prospects of the Company.

Smart Glass Industry Trends:

There are favorable converging global trends in the major near-term markets for smart glass and SPD-Smart products. The potential for smart glass products is significant and is expected to attain economies of scale with increasing high-volume production. This increased production is also expected to bring down end product costs and expand market opportunities.

In both public and private sectors across the world, there are substantial efforts targeted toward the promotion and use of energy efficient smart glass materials, including those used in automobiles, windows and other architectural glazings, aircraft and boats. Products using SPD-Smart technology continue to be exhibited at trade shows, conferences, and industry events, with such products not only being exhibited by our licensees but also by their customers and by OEMs. While there can be no assurance that these trends will continue, to the extent that they do continue, each is expected to have a beneficial effect on future interest in SPD-Smart technology.

In June 2018, Global Info Research issued a report Global Smart Glass Market 2018 by Manufacturers, Regions, Type and Application, Forecast to 2023. This market research report concludes that the smart glass market is expected to grow at a compounded annual rate of 19.2% over the next five years from $3.4 billion in 2017 to $9.8 billion by 2023.

In September 2017, MarketsandMarkets issued *Smart Glass Market by Technology (Suspended Particle Display, Electrochromic, Liquid Crystal, Photochromic, Thermochromic), Application (Architecture, Transportation, Consumer Electronics), and Geography - Global Forecast to 2023*. This market research report concludes that the smart glass market is expected to grow from USD $2.8 Billion in 2016 to reach USD $8.35 Billion by 2023, with a growth rate of 16.6% between 2017 and 2023. The study concluded that:

Key factors driving the growth of this market are the growing demand for smart glass in automobile applications, strong government support through mandates and legislations for energy-efficient construction, and optimal energy saving through smart glass applications.

Suspended Particle Devices (SPD) technology is expected to grow at the highest growth rate during the forecast period. Furthermore, the transportation market segment is expected to dominate the smart glass market during the forecast period.

A higher cost of smart glass is the major factor restraining the growth of the market. Manufacturers find it difficult to quantify the return on investment to end users and, hence, its application has been mainly across the high-end and luxury verticals. However, with the opening of large-volume manufacturing facilities, the manufacturers are expected to achieve economy of scale, which, in turn, will lower the cost. With the increasing volume of production, the cost of smart glass is estimated to reduce by 30%–40%.

Automotive Market:

In the automotive industry, global trends include the introduction of larger sunroofs and panoramic roof panels in transportation vehicles, and a higher percentage of these vehicles having a sunroof or using more glass in the roof.

SPD-SmartGlass has also been shown in armored automotive glass applications, recreational vehicles, and a new market is also beginning to develop for personalized custom conversions of automobiles for owners who wish to express themselves through the design of the cars they own and/or drive.

Aircraft Market:

In the aircraft industry, there is a trend towards larger windows with more passenger control and functionality. In the “transport category” (primarily large commercial passenger aircraft) segment, the world’s two largest aircraft manufacturers are both promoting the size of the windows in new aircraft platforms already being delivered (e.g. Boeing 787 and Airbus A350). In the “general aviation” category (primarily business jets, private or chartered smaller aircraft) this trend is true as well. For example, Gulfstream is promoting the size of the windows on their G650 platform, and Bombardier highlights the size of the cabin window on the upcoming Global 7000 and 8000 platforms. Several OEMs either already offer, or have announced their interest to include, electronically dimmable windows in their aircraft – including Boeing, Airbus, Bombardier, Embraer, Textron-Beechcraft, HondaJet, Airbus Helicopter, Bell Helicopter, Dassault, Epic and One Aviation.

Electronically dimmable windows for aircraft may use SPD technology, or may use other smart window technologies such as liquid crystal or electrochromic technology. A window system using electrochromic technology was introduced in the Boeing 787. There have been concerns raised that this aircraft’s electronically dimmable windows are

not dark enough for long haul flights, transmit too much heat into the cabin, and have a switching speed that is too slow.

The Company believes its SPD technology offers important performance advantages over other technologies including faster, more uniform response time, superior heat-rejection when the aircraft is parked on the ramp, superior acoustic insulation, an automated dimming system to continuously maintain a constant level of light in the cabin in real-time, and weight-savings. Leading companies manufacturing electromechanical pleated window shades have products that incorporate SPD-Smart windows into their designs, and Tier 1 suppliers of other cabin systems (e.g. cabin management systems) are featuring SPD-Smart electronically dimmable windows in mockups.

SPD technology is also the only commercially available light-control smart window technology known to have passed the stringent safety and durability tests required by the aviation industry and to have received a Supplemental Type Certificate (STC) from the Federal Aviation Administration. Today, SPD-Smart electronically dimmable windows are flying on over 40 models of various aircraft including those used in commercial aviation, general aviation and military aviation. SPD-Smart products have been selected by aircraft manufacturers as standard equipment on new production platforms including the Honda Aircraft HondaJet, Textron-Beechcraft King Air 250, 350i and C90GTx, Epic Aircraft E1000, and One Aviation Eclipse 700.

Architectural Market:

The architectural community is actively increasing the use of daylight harvesting, green building technologies and building automation systems to more effectively capture and control natural light as part of energy reduction strategies to offset cooling/heating costs and electricity used by artificial lighting. In addition to design, aesthetic and other benefits, the expanded use of glass also supports a growing body of research which finds that the presence of and control over incoming natural light improves an individual’s well-being and productivity. Products using SPD-Smart light-control technology – sunroofs, windows, skylights, partitions and others – can play an important role in supporting these converging global trends.

For architectural applications, various market forces and the distinctive features of SPD-SmartGlass are having a positive influence on interest for SPD-Smart products. Many architects are specifying more glass in their designs to satisfy building occupants’ desire for greater connectedness with the outside environment. In addition, there is increasing interest in improving energy efficiency in both commercial and residential buildings. Various studies indicate that buildings in the United States and Europe now account for an estimated 39-40% of total energy use and upwards of 70% or more of electricity consumption. Many architects and building owners are striving for sustainable, “green” buildings that are highly energy-efficient, reduce environmental impact, and improve occupant health and well-being. In addition, the design community is increasingly interested in advanced daylighting systems in buildings that lower electrical lighting usage and reduce heating and cooling loads. Because of this, the ability to control light, glare and heat in these building applications is very important and advanced solutions often are needed to optimize operating efficiencies. SPD-Smart architectural products instantly and precisely provide shading, glare control and heat management solutions for offices and homes, especially when these products are available for new construction, replacement and retrofit projects. These products include insulated glass units, single-panel retrofits, unusually shaped glazings, and products with advanced fabrications such as those with ballistic- and blast-resistant capabilities.

In 2015, Research Frontiers' patented SPD-SmartGlass technology was selected as the exclusive smart glass for the USA Pavilion at the World's Fair, Expo Milano 2015. The USA Pavilion featured 312 large panels of SPD-SmartGlass manufactured under license from Research Frontiers by Isoclima S.p.A. Each panel measures approximately 1 meter by 3 meters, making the total surface area in the roof more than 10,000 square feet. This is the largest known installation of smart glass in the world for a roof application and was seen by over 6 million people.

Marine Market:

In the marine application, where light-control needs are especially important, many yacht manufacturers currently employ less than ideal glazing solutions as they try to satisfy various shading and solar control objectives. For example, some report having to use as many as five different types of glass in a typical yacht to satisfy diverse glazing needs. SPD-Smart marine products can reduce the number of different types of glass used in these yachts because of its increased functionality, superior performance and versatility. SPD-Smart marine products provide an innovation that allows these operators to manage incoming light, glare and heat while achieving privacy or maintaining one's view as desired.

Historical Background and Recent Developments:

1. SPD-Smart Film Production

Hitachi Chemical

An important material used in SPD-Smart end-products is SPD light-control film that varies the tint of glass or plastic. In early 2007, our licensee Hitachi Chemical began producing their initial SPD-Smart light-control film on their first factory line. During the second half of 2009, Hitachi Chemical announced that they had begun mass production on their new, larger capacity production line and expanded their annual production capacity to 400,000 square meters (over 4.3 million square feet).

Hitachi Chemical's production line is dedicated exclusively to the production of SPD-Smart film. In July 2009, Hitachi Chemical launched its website dedicated to its SPD-Smart light control film and during 2009, Hitachi Chemical outlined in its press releases and public presentations that it plans to "accelerate the use of SPD film, which holds significant potential for growth" and noted that "SPD film is positioned as one of the key emerging products promoted by Hitachi Chemical to become a future leading product for the company."

Hitachi Chemical expanded its SPD film product portfolio by initiating commercial production of a "lighter" version of its film. Both the SPD "dark" and "light" versions of the films provide a high range of visible light transmission. The best-selling SPD "dark" film has a range of approximately 0.5% to 55.0%. This leads to contrast ratios (the ratio of clear to dark light transmission) of up to 110:1. The commercialization of both "dark" and "light" versions of SPD-film provides greater design and performance options for end-product applications.

Gauzy Ltd.

In October 2018, Gauzy Ltd. announced that it will be producing SPD-Smart light control film for the entire SPD-SmartGlass industry. The announcement came at a ceremony to celebrate the inauguration of Gauzy's production line to produce SPD-Smart light control film in Tel Aviv-Jaffo.

Gauzy has announced that it's Tel-Aviv film production line has a capacity to produce up to 364 thousand square meters of film per year per shift, and that it's initial production will be 1.2 meters wide, and in 2019 they will be expanding this to 1.5 meters wide rolls and in 2020 to 1.8 meters wide rolls.

In February 2019, Gauzy Ltd. announced its second production facility in Stuttgart, Germany to produce SPD-Smart light control film for the entire SPD-SmartGlass industry, and that this state-of-the-art facility with specially-designed coating and curing areas that will give Gauzy the capacity to coat over one million square meters of SPD film per year. Gauzy expects the new facility to be in production by the summer of 2019.

Customers for Hitachi Chemical's and Gauzy's SPD-Smart film are end-product licensees of Research Frontiers. These licensees receive the film, laminate it between glass or plastic substrates, and then fabricate end-products which are sold into various industries. Most end-product licensees pay Research Frontiers a royalty on the sale of these end-products that typically range from 10-15%.

Others

Other companies are currently licensed by Research Frontiers to sell SPD-Smart light-control film to other licensees of Research Frontiers. None of these other companies has yet announced commercial SPD film products for sale.

2. *SPD-Smart Automotive Products:*

Research Frontiers and its licensees are currently working with multiple automotive manufacturers to introduce SPD-Smart windows, sunroofs and roof systems on both concept and production vehicles. Research Frontiers' end-product licensees in this sector include American Glass Products, Asahi Glass, Custom Glass, Daimler AG, DuPont, Hanamac, Isoclima, Pilkington Glass, Pittsburgh Glass Works, Saint-Gobain Vision Systems, Tint-It JSC and Advnanotech. The Company's automotive glass licensees account for the majority of all glass produced for the automotive market throughout the world.

Automotive OEMs:

In 2011, Daimler AG began using SPD-SmartGlass technology in its Magic Sky Control™ panoramic glass roof as an option on its new Mercedes-Benz 2012 SLK. In 2012, Daimler AG began offering its Magic Sky Control™ panoramic glass roof as an option on its new Mercedes-Benz 2013 SL. These SPD products allow drivers and passengers to change the tint of the car roof from dark to clear quickly with a touch of a button. The SLK and SL are the first large-scale series production vehicles to offer SPD-SmartGlass. The Research Frontiers licensees involved with the production of the Magic Sky Control™ roof for the SLK and SL include Hitachi Chemical, which manufactures the SPD-Smart light-control film in Japan. Automotive glass companies Nippon Sheet Glass in Japan and its subsidiary, Pilkington, in the UK and Germany then process and laminates Hitachi's SPD film into the glass for the Magic Sky Control™ roof.

In late 2014, Daimler AG began offering its Magic Sky Control™ as an option on the new Mercedes-Benz S-Class Coupe. In 2015 other S-Class variants (i.e. Standard Wheel base W222, Long Wheel Base V222, Maybach S600 X222 and the Maybach Pullman Limousine) began offering Magic Sky Control™ as an option. The all-new Mercedes-Benz S-Class is the third large-scale serial production vehicle to offer Magic Sky Control™ using SPD-Smart technology. The Research Frontiers licensees involved with the production of the Magic Sky Control™ roof for the S-Class include Hitachi Chemical, which manufactures the SPD-Smart light-control film and Asahi Glass Corporation which then process and laminates Hitachi's SPD film into the glass for the Magic Sky Control™ roof.

The S-Class Coupe offers the largest panoramic Magic Sky Control™ roof ever put into serial production. The surface area of the panoramic roof using SPD-SmartGlass technology on the S-Class is approximately three times the size of the roof glass used on the current SLC and SL roadster. With the addition (announced in August 2017) of the new 2018 S450 and S450 4MATIC S-Class Sedans, a total of 14 Mercedes-Benz model variants now offer this remarkable panoramic smart glass roof:

S 450 S-Class Sedan

S 450 4MATIC S-Class Sedan

S 560 4MATIC S-Class Sedan

AMG S 63 S-Class Sedan

Mercedes-Maybach S 560 4MATIC

S550 4MATIC S-Class Coupe

AMG S63 S-Class Coupe

AMG S65 S-Class Coupe

SLC 300 Roadster

AMG SLC 43 Roadster

SL 450 Roadster

SL 550 Roadster

AMG SL63 Roadster

AMG SL65 Roadster (Standard Equipment)

A key factor in the broad adoption of SPD technology in various automotive windows is its cost. Typically, the cost for new technology products decrease as production volumes increase. The price per square foot of SPD-SmartGlass reported by our licensees has gone down over time in the automotive market. Royalties from the Magic Sky Control panoramic roofs generate a royalty of 10% of the selling price of these roofs by our licensees to Daimler. The roofs on the S-Class is approximately two to three times the surface area of the roofs on the SLC and SL vehicles.

Research Frontiers believes that the addition of the S-Class car model is also significant since it applies our SPD-Smart light-control technology to the broader class of vehicles by moving beyond roadsters to coupes and passenger sedans. Historically, since its debut over 40 years ago, the S-Class represents the premier platform to introduce new technologies to the customer, which in many cases expand to the other less expensive model lines within the Mercedes-Benz brand.

In November 2015 at the Los Angeles Auto Show, Mercedes-Benz launched a refreshed Mercedes-Benz SL. The press release from Mercedes-Benz it stated, “Another feature which has been retained is the unique optional extra MAGIC SKY CONTROL: when closed, the panoramic vario-roof automatically changes from dark to transparent or vice-versa within just a few seconds.” The MAGIC SKY CONTROL feature is a carry-over from the previous model. Other new features include a new front end, new headlamps, more powerful engines, a new transmission, among many others.

In January 2016 at the North American International Auto Show in Detroit, Mercedes-Benz premiered the new Mercedes-Benz SLC. The press release from Mercedes-Benz when the SLC was first announced stated, “A feature that continues to be unique to the SLC is the panoramic vario-roof with Magic Sky Control – this glass roof is lightened or darkened at the touch of a button. This means that it provides an open-air feeling at any time, but when required gives welcome shade under a hot sun.” The Magic Sky Control feature, using Research Frontiers SPD-SmartGlass technology, is a carry-over from the SLC’s predecessor model, the SLK roadster.

Other automakers continue to develop and evaluate the use of SPD technology in their windows systems. Such window systems include sunroofs, side-windows, rear-windows and front-window visors. Some automakers and their suppliers have incorporated SPD-SmartGlass in concept vehicles, with some of these concept vehicles being exhibited at major auto shows:

March 2019:

At the 2019 Geneva Auto Show Mercedes-Benz SLC roadster, SL roadster, S-Class Sedan and Maybach vehicles in serial production which was presented using the Company’s SPD-SmartGlass technology.

In addition, two new production cars by McLaren Automotive featured SPD-SmartGlass technology in their roofs: the McLaren 720S Spyder and MacLaren Speedtail. The McLaren 720S Spyder is currently in production and the McLaren Speedtail is expected to be in production in 2019 with delivery to customers to begin in January 2020.

January 2019:

At least four different companies showcased SPD-Smart products at CES 2019 in the automotive and consumer electronics industries.

November 2018:

Two concept electric vehicles debuted at the 2018 Los Angeles Auto Show featured SPD-SmartGlass. These two vehicles are scheduled to be in production in 2020.

At electronics 2018 in Munich in November, Texas Instruments demonstrated a control unit reference design (TIDA-020013) created to more intelligently and efficiently power SPD-SmartGlass electronically dimmable glass using a standard 12-volt automotive battery. The interactive demonstration is paired with gesture control to lighten or tint glass with the SPD-SmartGlass technology.

The SPD-SmartGlass sunroof application, supplied to Texas Instruments by VariGuard, gives occupants more control over the lighting in their car, removes unwanted heat, light and glare, and increases the driving range of electric vehicles. It also miniaturizes the electronics package and reduces the cost of the entire system to the auto maker, while also improving power efficiency. Engineers can use the TI reference design to accelerate their own designs using electronically dimmable glass. The design includes TI's highly efficient power management circuits and a 32-bit C2000™ real-time MCU to help generate the necessary signal to drive and control substantial surface areas.

January 2018:

A number of different companies showcased SPD-Smart products at CES 2018. In the automotive industry, Fisker debuted its new Fisker E-Motion with a unique and innovative four-segment SPD SmartGlass roof. In addition to use in its large curved panoramic roof, Fisker says that it plans to offer SPD-SmartGlass technology on the side windows of this new electric vehicle.

Continental Corporation ("Continental") also showcased their Intelligent Glass Control system using SPD technology at CES 2018 to demonstrate how it makes cars safer, more private and comfortable, lighter and more energy-efficient.

January 2017:

Corning introduced a concept car that features an SPD-SmartGlass panoramic roof and rear glass at the 2017 Consumer Electronics Show. This large roof and curved rear glass is made using SPD-SmartGlass light-control film laminated between Corning's Gorilla® Glass, a special chemically-strengthened thin and lightweight glass.

At the 2017 Consumer Electronics Show, Continental Corporation ("Continental") showcased an advanced version of its SPD-equipped vehicle that it originally showcased at the 2016 Consumer Electronics Show. This vehicle has enhanced and more sophisticated electronics, Continental indicated that its Intelligent Glass Control system increases passenger comfort and lowers CO2 emissions by keeping the interior of the vehicle cooler. As a result, smaller, more efficient and lighter air conditioning units could be used. Calculations showed a reduction in CO2 emissions of four grams per kilometer. Continental also estimates that their Intelligent Glass Control system can increase the driving range of electric vehicles by 5.5%

January 2016:

Continental Corporation showcased its "Intelligent Glass Control" system on a demonstration vehicle at a special event at the Consumer Electronics Show (CES) in Las Vegas. This vehicle, a Ford Mondeo station wagon, used SPD-SmartGlass technology to enable the glass in all eleven side and rear windows and in the top sunvisor portion of

the windshield to change its transparency and darken instantly through electric control signals.

March 2015:

The Lincoln Motor Company, the luxury automotive brand of the Ford Motor Company, introduced the Lincoln Continental Concept car using an SPD-SmartGlass electronically tinting sunroof. This Lincoln Continental Concept car featuring SPD-SmartGlass also made its Asian debut at Auto Shanghai in April 2015.

September 2012:

BMW debut at the Paris Motor Show its new BMW Concept Active Tourer. This vehicle’s entire composite glass roof uses patented SPD-SmartGlass technology.

March 2012:

Mercedes-Benz debuted at the Geneva International Motor Show its public evaluation of the Limited Edition Viano Pearl. This vehicle displays the capabilities and conceptual use of SPD-SmartGlass on the side glass of vehicles from Mercedes-Benz.

December 2011:

Toyota debuted its FS Hybrid Concept at the 2011 Tokyo Motor Show in Tokyo, Japan. The FS Hybrid Concept demonstrated the use of SPD-Smart™ technology in side glass.

September 2011:

Audi debuted its A2 concept car at the Frankfurt International Auto Show in Frankfurt, Germany. The A2 is an electric-powered passenger car equipped with a large SPD-Smart™ panoramic glass roof.

3. Automotive Aftermarket: