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RESEARCH years FRONTIERS SmartGlass.com



Research Frontiers (Nasdaq: REFR) Company Overview

SPD-Smart Technology: Electronically tintable glass developed by **Research Frontiers** changes the tint of any window, sunroof or skylight by electrically aligning tiny particles in a thin film within the glass or plastic. With the touch of a button, users can instantly change or tune the tint of their glass to help keep out harsh sunlight and 95% of the heat in its tinted (power off) state. Patented SPD-SmartGlass technology effectively blocks UV and infrared rays regardless of whether the glass is in its clear or tinted state, helping keep cars, planes, yachts, homes, offices and artwork cooler and protected.

NASDAQ	REFR
Market Cap (\$4.21)	\$132 M (5-21-2020)
Shares Outstanding	31.4 M
% Ownership by Management	7.6%
Cash Expenses (Annual)	\$3.0 M
Cash Burn Rate (Quarter)	\$450K
Working Capital	\$6.3 M (Q1-2020)





Status:

- Cumulative investment of over \$100 million in SPD-SmartGlass (\$71.4 million NOL) 235 worldwide patents issued (expiring 2020-2037)
- Over 45 companies have already licensed SPD-SmartGlass technology, including a majority of the world's automotive glass producers
- Licensor of world's best-selling and best performing smart window technology
- Daimler adopted SPD technology in the Mercedes-Benz SLK in 2011, SL in 2012, S-Class Coupe in 2014, S-Class Maybach and S550 sedan in 2016. Now also in 4 models of McLaren and also electric vehicles
- SPD-Smart windows are standard equipment on 7 different aircraft models and aftermarket upgrade on 40 aircraft models.
- Automotive, Aircraft, Marine, Architectural and Museum Protection projects around the world. New consumer electronics applications being developed.
- Milan World's Fair Allowed Over six million people to experience SPD-SmartGlass







Major Existing Markets for SPD-Smart Products

Automotive





Trains





Aircraft

Other Products

Architectural







SPD-SmartGlass (What is it?)





Daimler explains SPD-Smart technology in their Magic Sky Control roof



SPD-SmartGlass (Benefits)



SPD-SmartGlass Performance Characteristics and Benefits

- Offers a unique combination of performance benefits not found in any other smart glass technology, including:
 - Fast transition speed (2 seconds) between widest range of light and dark tinted states. Speed is not size-dependent!
 - 50-60 times darker to about twice as clear as ordinary sunroof.
 - 20-70 times darker than conventional tinted glass to about five times as clear.
 - Tinted state rejects up to 95% of heat and 99+% of UV radiation while not consuming any power.
 - Mercedes tests show 10°C (18°F) reduction in cabin temperature.
 - duces CO2 emissions by 4g/km and improves gas eage/driving range by 5.5%.
 - Infinite tunability between light and dark tinted states.









Closer look at SPD-Smart Benefits: Protection from Heat, UV, Light and Glare

UV radiation damages interiors.

But other forms of solar radiation are primary culprits as well.

> Switch to maximum visible light blocking state (99.5% blockage(when off (no power consumed)



Full-time 99.9% of UV radiation blockage (full time-no power consumed)

Switch to maximum heat-blocking state (-18F/-10C) when off (no power consumed)



Benefits in Green Buildings

- Energy efficiency
- (Buildings use 41% of energy and 73% of electricity)
- View preservation
- Occupant well-being
- Environmental stewardship
- Buildings as "smart" systems
- Innovation and aesthetics
- Differentiation



Daylight Harvesting Potential annual savings of 35% to 60% on lighting energy.





SPD-SmartGlass (Development Status: Commericialized!)





OFFICIAL SMARTGLASS OF THE USA PAVILION AT EXPO MILANO 2015



SPD-SmartGlass





SPD-SmartGlass (Existing Markets and Growth Opportunities)



Opportunities:

- Established customer base
 - Over 45 licensees
 - Key high profile launch customers
- Reliability of SPD-SmartGlass already demonstrated by Mercedes and others
- SPD-SmartGlass has proven performance advantages over other technologies
- Clear potential to achieve much higher growth rates and valuations in market
- Licensing royalties business model based on sales of SPD-SmartGlass endproducts (10 - 15% royalty fee range)
- Business model is highly scalable minimizing capital expenditures and operating 0 expenses as SPD-SmartGlass business expands











AUTOMOTIVE MARKET

•Credibility of Mercedes as launch customer

Trends in Automotive Industry favorable
Strong premium market
Move towards electric vehicles
\$105/gram CO2 emissions penalty (\$420)
Move towards connected cars
Move toward autonomous driven vehicles

•Predictable, high volume business

•High visibility "moving billboards"

•Interest well beyond just Mercedes ...



Once Hitachi Chemical put SPD-Smart film into commercial production in 2007, Daimler started a multi-year testing and development program for the new SLK Roadster (launched in serial production in 2011):

Product Introduction Chronology: SPD-SmartGlass in Passenger Cars



March 2011 Mercedes-Benz SLK world debut at Geneva Auto Show. First Car To Use SPD-Smart Technology.



January 2012 Mercedes-Benz SL world debut at the Detroit Auto Shows. The Second Car To Use SPD-Smart Technology



2011

2012

September 2011 Audi Premieres A2 Concept Car With SPD-SmartGlass roof at 2011 Frankfurt Auto Show.



March 2012 Daimler Limited Edition of the Viano Pearl . Daimler 's public evaluation of SPD-SmartGlass concept in side windows. SPD-SmartGlass concept in side





Second Half 2014 Multiple variants of the Mercedes-Benz S-Class family (Coupe, Maybach, Sedan) become the third, fourth and fifth cars to use SPD-SmartGlass, moving beyond roadsters to coupes and passenger sedans.

2014

2015



March 2015 Lincoln Premieres the Continental Concept with SPD-SmartGlass roof at the New York Auto Show



Fisker EMotion SPD-SmartGlass on Roof and Rear Side Windows











The Latest from the Geneva Auto Show March 2019: The McLaren 720S Spyder and McLaren Speedtail with SPD-SmartGlass Roofs





TRAIN MARKET

















MARINE MARKET









•Vision Systems SPD-Smart Nuance Windows:

- Information on your window
- Photovoltaic self-powered smart windows
- Gesture-controlled and segmented windows
- Integrated electronics
- Nuance V2

ARCHITECTURAL MARKET









SPD-SmartGlass (Growth Opportunities)



Main Catalysts: Movement to Higher Volumes

• Automotive •S-Class Sedan •Other Automotive OEMs •Cost Reductions/Higher Volume •Movement of industry towards electric vehicles, autonomous vehicles, and connected cars •Need to reduce CO2 emissions (\$450 benefit)

•Aircraft

•Movement to transport category aircraft •Other OEMs •Aftermarket



Other Growth Areas: Movement to Higher Volumes

•Architectural Green Construction Cost Reductions/Higher Volume

•New Markets •Yachts/Cruiseships •Trains/Mass Transit •Museums Projection and Television (Panasonic) and Heads Up Displays New Products using SPD Technology







Market Expansion Results in Need for Competitive Supply Chain and **Less Expensive and Wider SPD Film** to Address the needs of the Architectural Market



Gauzy Ltd. SPD-Smart Film Coating Line (Announced October 9, 2018)



(Production Capacity 365,000 square meters/year/shift)

SPD film supplied by Gauzy Ltd.

Gauzy Ltd. and RFI Announces <u>Second</u> SPD-Smart Film Coating Line in Stuttgart, Germany (Announced February 1, 2019)



(Production Capacity: Over 1 million square meters, width 1.8 Meters)



Gauzy Factory Opening Stuttgart, Germany-December 5, 2019



SPD-SmartGlass (Market Size)



Smart Glass Market Overview

In October 2019, 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. Key conclusions in this report included:

- construction spaces more environment-friendly.

• Smart glass, especially active glass, provides a higher control over heat and light at the will of the user, thereby providing considerable electricity cost-savings and conclusively making the

• Smart glass technology has been in existence for the last few decades; however, its demand is gathering momentum on account of improved innovation in raw materials and technologies and the possibility for new applications across various sectors. North America and Europe have been at the forefront of this trend. Smart glass demand is growing in the Asia Pacific region on account of its growing building and construction, electronics, and transportation sectors.







Market Overview: Automotive Market

- IHS Automotive Approx 90 million units in the Global Light Vehicle Market
- Approximately 3% of this total (2 million units) were luxury vehicles with a US\$ MSRP ≥ \$50K*
- Approximately 1.6 million of these luxury vehicles have sunroofs that generate glare and heat control issues*
- Expansion of SPD-SmartGlass to other areas of car

The luxury vehicle sunroof market alone represents a \$200 million annual revenue opportunity at current royalty rates







Market Overview: Aircraft Market

- 35,000 new transportation and business jets are forecast to be produced over the next 20 years
- These jets will create annualized demand for 157K aircraft windows, each requiring a shading product
- Commercial airliner market is 91% of the total aircraft market

The aircraft market is a \$24MM annual revenue opportunity at an estimated royalty of \$75-150 per window

*Sources: (i) Boeing Current Market Outlook 2013-2032 and (ii) General Aviation Manufactures Association 2012 Statistical DataBook and Industry Outlook.









Additional Growth from Aftermarket

•SPD EDWs can be retrofitted because there is no change needed to structural outer window.

•Aftermarket can be many times larger than OEM market.

•Upgrades can occur during maintenance and when aircraft ownership changes.





Vision Systems and RUAG installation on Dassault Falcon 900



Architectural Smart Glass Company Valuations

Competitor	Equity Valuation	Not
View Dynamic Glass	\$??? B	Most
Sage Electrochromics, a division of Saint-Gobain	\$160 M	In 202 M equity \$250 stake
Research Frontiers	\$132 M	As of

(1) Faribault Daly News – May 9, 2012

(2) Star Tribune – October 1, 2013

Note: Research Frontiers main competitors in the architectural smart glass market, Sage and View, do not participate in the other (automotive, aircraft, marine and museum) markets that Research Frontiers technology is also used in.



es

recent investment of \$1.2B. Total raised to date over \$2B.

10, Saint Gobain acquired a 50% stake in Sage for \$80 M implying a \$160 uity valuation⁽¹⁾. In 2013, Saint Gobain acquired the remaining 50% of the y of Sage. The CEO of Sage indicated that Saint Gobain invested a total of MM in Sage in addition to the price it paid for the remaining 50% equity ⁽²⁾.

5/21/2020



SPD-SmartGlass (What does it compete with?)



PERFORMANCE COMPARISON OF ACTIVE (SMART) TECHNOLOGIES:

LC (Liquid Crystal)

- Scatters but does not block/reflect incoming light
- Only two states: clear and translucent
- Good privacy but no shading
- Hazy
- EC (Electrochromic/Electrochemical)
 - Very slow, non-uniform switching speed
 - Switching speed degrades substantially as product size increase
 - Typically only offered in two states: tinted and clear
 - Difficult to achieve "very dark" states
 - Cannot be integrated with lightweight plastics
 - Electrochemical process may have durability issues (similar to laptop battery)

SPD (Suspended Particle Device)

- vitching speed: Instant regardless of product size
- Tunability: Infinite intermediate states from dark to clear
- markets

 Light-Blocking Capability: Typically 99.5% blockage. Can be as low as 99.9975% blockage Proven real-world durability: Tested in most extreme conditions in automotive and aircraft



Competitive Landscape for SmartGlass Technologies

Automotive SmartGlass Applications: ightarrow

Aircraft SmartGlass Applications:

SPD technology have been commercialized in various aircraft. EC has only been commercialized in two aircraft, and one of them subsequently converted to now using SPD. The Company believes that SPD's superior switching speed versus EC is a key competitive advantage.

Architectural SmartGlass Applications: •

SPD, EC and LC have been utilized in various applications. The Company believes that SPD's superior switching speed versus EC, and its ability to darken (vs LC light scattering) are key advantages of SPD versus these technologies.



SPD is the only technology that has been commercialized. EC and LC have been evaluated but have not had the performance properties to be successfully deployed.

Ownership

- Directors & Officers (April 2020 Proxy):
- 5% Stockholders:

Kevin Douglas and related group: Gauzy, Ltd.:

- **Total Shares Outstanding:**
- Employee Options (2019 Form 10K): (\$3.68 Weighted Average Exercise Price)
- Warrants & Non-Employee Options (2019 Form 10K): (\$2.13 Weighted Average Exercise Price)

7.6%

12.5% 5.9%

31,411,107

1,548,351

1,483,143



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Thank You.

