VISION SYSTEMS AND RESEARCH FRONTIERS BRINGS TOGETHER THE COMBINED RESOURCES TO PRODUCE HIGHEST-PERFORMING EDW

News / Events / Festivals, Manufacturer

Over nine years ago Research Frontiers Inc. and Vision Systems launched a development program together with one goal in mind: to bring the best experience possible to passengers on aircraft. Joining this effort were Hitachi Chemical and Gauzy, which now have production lines in Japan, Israel and one now being built in Germany, to produce SPD-Smart light-control film used in Vision Systems' electronically dimmable windows (EDWs).

This week, at the Aircraft Interiors Expo (AIX) in Hamburg, visitors are seeing the results of an estimated $200+ million investment by these companies to bring the best in comfort, enjoyment, safety and functionality to airline passengers. The performance and reliability of these Vision Systems' products surpass all other products on the market, including "electrochromic" EDWs.

Carl Putman, President of Vision Systems noted: "The airline industry's experience with EDWs has clearly shown that passengers do not want to wait minutes for their window to shade, want any electronic switching to be uniform and instant to avoid the "doughnut hole" effect often noticed by passengers with electrochromic windows on aircraft, and want to reject unwanted heat and glare from the cabin. In all of these categories, the SPD-Smart light control technology that we use in our Nuance and Noctis EDWs far outperforms existing electrochromic technology in use on the Boeing 787."

Joseph M. Harary, President of Research Frontiers added: "Research Frontiers, Gauzy, Hitachi and Vision Systems have all made substantial investments in world-class R&D, engineering and production facilities producing the highest performing smart window technology in the world. And products using Research Frontiers' technology have been reliably used for many years in some of the most extreme environmental conditions on earth. When world class material science meets focused product engineering and a dedication to producing 'the best or nothing" for the world's most discerning customers, the results become apparent."

The film used in Vision Systems' EDWs, invented and patented by Research Frontiers, is the core component in SPD-SmartGlass systems – allowing users to instantly, precisely and uniformly control the shading of glass or plastic, either manually or automatically. Products using Research Frontiers' SmartGlass technology are being used in tens of thousands of cars, aircraft, yachts, trains, homes, offices, museums and other buildings. SPD-Smart light control technology is also the longest EDW technology in use in the aircraft and automotive industries.

The goal in commercial aviation is to improve the passenger experience, and meeting this major industry goal has been the SPD industry's collaborative focus of the technological and product development effort. The latest generation of Vision Systems' SPD-Smart EDWs offer potent and unique solutions to improving how passengers feel while in flight. By allowing passengers and flight crews to precisely tune the tint of the SPD-Smart EDW to control the amount of daylight coming through windows, passengers continue to comfortably enjoy views, rather than blocking their view with a shade. The system delivers other important passenger experience benefits including a cooler and quieter cabin due to remarkable thermal and acoustic insulation.

Vision Systems' SPD-Smart EDWs Block More Heat

Making the Aircraft Cabin More Comfortable

Transmission of solar radiation through cabin windows has historically been the weak link in providing airline passengers relief from oppressive outside elements including heat. Vision Systems SPD-Smart EDWs beat the sources of heat before they enter the cabin to improve the passenger experience and to help operators reduce on-ground cooling requirements. "Electrochromic" technology does not.

In an aircraft, the increase in cabin temperature resulting from solar radiation entering through windows is most potent when on the ground, and passengers suffer as a result. Cabin warming results from IR radiation and from visible light entering through windows, in approximately equal amounts. During boarding and disembarking, heat generates discomfort for the passengers and implies strong air-conditioning… unless the aircraft uses Vision Systems SPD-equipped EDWs.

Vision Systems' EDWs include very high-performing IR-blocking materials to protect from the portion of cabin heating that is due to IR rays. However, IR radiation only represents part of solar heat gain through windows. The portion of the solar spectrum that we can see – Visible Light – is about an equal contributor to an aircraft cabin interior rapidly becoming hot on the ground. For

passenger comfort, *visible light must be blocked*. Vision Systems' SPD-based EDWs provide the solution by automatically switching to their darkest, maximum heat-rejecting state when unpowered on the ground.

In stark contrast to SPD-Smart EDWs, electrochromic EDWs switch *transparent* when the aircraft is unpowered, letting a source of heat invade the cabin, because a transparent EDW is in its most heat-transmissive state. Electrochromic EDWs can be switched dark but only if costly on-board or ground power is applied. Also, electrochromic technology uses a chemical reaction to change states, and this is an exothermic reaction, meaning that heat is *released* into the cabin when the EDW is in the dark mode. (An electrochromic EDW operates like the charging and discharging of a battery.) SPD does not use a chemical reaction, and no heat is released in either its dark or clear states.

No manual intervention by passengers, flight crews, or ground crews is required for Vision Systems' EDWs to switch to the maximum heat-blocking state when needed most, and operators' costs in air-conditioning are significantly reduced. Passengers embark and disembark in a cool cabin, enjoying greater thermal comfort for a better well-being. (For airlines that want the windows to be clear at certain times, Vision Systems EDWs and certified electronics can easily integrate with cabin management and safety systems on the aircraft to automatically and instantly go to a clear state when passengers need the assistance of light coming through the aircraft windows.)

Vision Systems' SPD EDWs Switch Tint Substantially Faster with Better Uniformity, Giving Passengers Instantaneous Control Over their Environment

Vision Systems' SPD-Smart EDWs have a switching speed of 0.65 seconds from the darkest tint to the clearest state, against switching speeds measured in minutes for electrochromic EDWs, and 3 seconds from clearest to darkest, regardless of the size of the window. This enables passengers to instantly change the opacity of their window to regulate daylight and glare. Instant relief from oppressive light and glare is vital to passenger comfort onboard aircraft. Instant privacy is also offered in Vision Systems' EDWs.

Vision Systems' SPD EDWs Replace the Window Opening's Plastic "Dust Pane,"

Offering Superior Optical Properties, and Saving Fuel and Cabin Space

The latest generation of Vision Systems' EDWs provide unprecedented optical performance with haze well below the visible threshold for their "Nuance Dark" brand of SPD-Smart EDW solution. There is another *very* important aspect to the view out the window experienced by passengers. With SPD technology, Vision Systems' EDWs use extremely thin, lightweight, scratch-resistant chemically strengthened glass. Because of this, their EDWs can replace the window opening's traditional "dust pane" – the plastic window closest to the passenger. Dust panes are well known to be poor optically – after minimal use, they become scratched, hazy and have other deficiencies – and they degrade passengers' experience looking out the window.

In addition to delivering superior optical performance, Vision Systems' ability to locate SPD-Smart EDWs in place of dust panes offer passengers and airlines other benefits. For example, the net weight of the window assembly is reduced, which reduces fuel consumption. Also, this can save interior cabin space – an ongoing industry objective.

This feature is another major advantage Vision Systems has against electrochromic EDWs. Unlike an SPD EDW, electrochromic EDWs cannot replace the dust pane – it is still required. Instead, the EDW must be *added* to the traditional window assembly – they must be integrated between the

dust pane and the outermost “structural window,” with air gaps in between each type of transparency. This is a much heavier window assembly configuration, takes up more space, and the passengers still must endure the inferior optics of the dust pane.

Vision Systems’ SPD EDWs Reduce More Noise Inside the Cabin

Transmission of noise through cabin windows is the weak link in providing passengers relief from another type of outside element. A quieter aircraft cabin is a major industry objective, and Vision Systems provides the superior solution in this area as well. SPD technology is film-based, and the EDW’s multi-layered laminated fabrication involves other noise barriers providing acoustic insulation for a quiet atmosphere. Electrochromic EDWs have inferior noise attenuation performance because of the nature of the materials used and how they must be configured.

Vision Systems’ SPD EDWs Add More Unique Functionality Inside the Cabin

Vision Systems’ in-house developed control switch electronics are fully integrated directly into the window. This facilitates rapid installation during new construction as well as for aftermarket upgrades. It also reduces maintenance expenses. In contrast, electrochromic EDWs cannot integrate control switch electronics on the window, because these EDWs are located behind the window opening’s plastic dust pane. Without the possibility of integration, it is necessary to locate the control switch on the seat or lining. During maintenance of an electrochromic window, multiple aircraft interior components must be removed in order to access the EDW.

Multiple models of Vision Systems’ EDWs are available to meet the customer requirements:

- multizone tinting
- additional PDLC film for blackout and privacy
- inclusion of an integrated information display
- integrated plain or transparent touch panel
- The control of the window is also compatible with any Cabin Management System (CMS).

The following chart summarizes some of the performance advantages

Vision Systems’ SPD-Smart EDWs have over electrochromic EDWs

	SPD-Smart EDW	**Electrochromic EDW**
Switching Speed	0.5 – 3 Seconds	Minutes
Uniform Tinting	Yes	No
Heat-Blocking When Aircraft on Ramp and Unpowered	Extremely High: Switches to Darkest State	Poor – Moderate: Switches to Clearest State
Noise Blocking	Extremely High	Poor – Moderate

Multizone Tinting	Yes	No
Replaces Dust Pane	Yes	No
Integrated Electronics	Yes	No
Ability to Include PDLC Film For Additional Blackout and Privacy	Yes	No
Integrated Information Display	Yes	No
Integrated Touch Panel	Yes	No

The SPD-Smart Technology Has Been Reliably Used for Years

in Some of the Most Extreme Environments on Earth

The markets for SPD-Smart film are well-established. Research Frontiers has licensed over 40 chemical, film, and glass companies which are selling products for the automotive, aircraft, marine, train, architectural, museum, and consumer electronics industries.

Research Frontiers patented SPD-SmartGlass technology is the same best-selling smart window technology that can be found on various car models from Daimler. The MAGIC SKY CONTROL feature, which is now in use on tens of thousands of Mercedes-Benz SLs, SLC/SLKs, Maybach and S-Class models around the world, use patented SPD-SmartGlass technology developed by Research Frontiers to turn the roof transparent by electrically aligning tiny particles in a thin film within the glass. With the touch of a button, drivers and passengers can instantly change the tint of their roof to help keep out harsh sunlight and heat, and create an open-air feeling even when the sunroof is closed. Glass or plastic using Research Frontiers' patented SPD-SmartGlass technology effectively blocks UV and infrared rays in both clear and darkly tinted modes, helping keep the cabin cooler, and protecting passengers and interiors while also enhancing security inside the vehicle. These benefits become even more important when a car uses large surface areas of glass, especially in warm climates.

Some of the other benefits of SPD-SmartGlass include significant heat reduction inside the vehicle (by up to 18ºF/10ºC), UV protection, glare control, reduced noise and reduced fuel consumption. Independent calculations also show that use of SPD-SmartGlass can reduce CO2 emissions by four grams per kilometer, and increase the driving range of electric vehicles by approximately 5.5 percent.

Shortly after its introduction into serial production in the automotive industry, SPD-SmartGlass has become standard equipment on many different aircraft, and is also used in residential and commercial architectural applications, in trains, yachts and other marine vehicles, in display applications, and to protect light-sensitive artwork and documents in major museums around the world.

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