

The Future of Fenestration

By Carol Lamkins, CID, CMKBD

Interior design is impacted by natural light. The consumer preference is for bigger-sized windows that capture natural light and bring the beauty of the outdoors inside. The change-out and resizing of windows can significantly influence the space planning of furnishings, textile selections and color schemes. Therefore it is important that Interior designers be aware of window options and technology when advising clients.



Courtesy of OJO Images

High performance windows include energy efficiency. The Department of Energy (DOE) reports that energy loss through windows accounts for 30% of heating and cooling use in the United States. This loss can be offset by double or triple paned windows designed with krypton and argon gases sealed between the panes, low-E coatings that reflect heat, and thermally broken window frames. Some manufacturers have gone beyond the DOE standards by reducing heat loss by more than 50%. As energy prices rise, consumers will continue to ask for these types of features to offset energy costs that are due to temperature transfer through glass.

The 2011 edition of the "North American Fenestration Standard/Specification for windows, doors, and skylights" was created by representatives of the American Architectural Manufacturers Association (AAMA), Window & Door Manufacturers Association (WDMA), and the Canadian Standards Association (CSA). NAFS-11 already is referenced in 2012 editions of the International Building Code

Specific changes for improved performance made in NAFS-11 include:

- new product criteria sections for parallel opening windows and secondary storm products,
- expanded information on tubular daylighting device products to include closed- and open-ceiling options,
- new ratings and designations on mullions,
- added requirements on lead content for hardware,
- and a general restructuring of the standards that created separate sections for products and materials and components

Energy Star standards and LEED points motivate architects, designers and builders to select high performance windows. DOE has established a High Performance Windows Volume Purchase Program to provide incentives to window manufacturers. This increases the choices of manufacturers and products for the consumer. The U-values can be as low as 0.18 and low-E, gas-filled, triple-paned glass. Warm-edge insulated glass clears condensation, and a secondary glazing panel within the sash holds glass up to 1/4 inch thick. An added advantage to these systems is noise control using multiple air- and noise-blocking weather strips.

Window styles include stationary, double-hung, slider, casement, bay and awning window styles as well as picture and fixed geometric shapes for replacement and new

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construction. Other amenities include custom hardware, interior wood-grain laminates, wood-vinyl composites, profiles, grille styles, and a variety of exterior colors. Many frame colors are available that never need painting. Also available are low-maintenance trims that snap on in minutes and also never require painting.

Window frames from some manufacturers have been engineered to resist warping, fading, and cracking, the finishes reflect sunlight, preventing heat build-up from ultraviolet, infrared, and visible light. The surface resists chips and scratches and can withstand extreme heat and freezing cold. Some feature an extruded aluminum frame that glides smoothly and auto-locks shut.



Switchable, dimmable, projectable glass by Glass Apps

Interior design is also impacted by rapidly expanding glass technology. Window treatments installed for privacy, light filtration, climate and sound insulation become unnecessary with the use of Smart Glass, E-glass or switchable glass windows.

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Current Smart Glass technologies include:

1. electrochromic devices
2. suspended particle devices
3. micro-blinds
4. and liquid crystal devices

In general these technologies allow glass to electronically switch between transparent and opaque light transmission states when voltage is applied. These technologies changes smart glass or film from clear and opaque on demand and provides unprecedented control over the amount of light and heat that enters the building or residence. Liquid crystal replacement glass or film is easily applied to existing glass for privacy, temperature and light management used in commercial building and residential spaces.



Polyvision Smart Glass, clear mode



Polyvision Smart Glass, projection mode

In general, Smart glass or film does not need additional blinds, shades or other window treatments. This results in unobstructed views for the occupants. The finished glass and film are also a novel platform for projection and touch screen effects that can transform store windows, showrooms, and any glass surface into dramatic video displays. Many department and clothing stores are adding these video effects in their interiors to promote their products. Imagine a giant screen video and audio with runway models in action wearing the clothing sold in the store.

Available as a glass, film, or even adhesive, the product can bring these exciting effects to literally any new or existing glass surface. The film colors come in white, light gray, dark gray and light blue.

Other features include

- UV block: more than 98%
- Solar reduction: 40%
- Operating temperature: -68°F ~ 140°F
- Power consumption: 0.65W per sq. ft.
- Switching Speed: less than 10 milliseconds

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Smart Glass is switchable, dimmable, and projectable. Sound can also be controlled with the touch of a switch. Detailed below are the four basic types of Smart Glass available today.



Soundproof smart glass "on"



Soundproof smart glass "off"

- 1. Electrochromic devices** change light transmission properties in response to voltage and thus allow control over the amount of light and heat passing through. In electrochromic windows, the electrochromic material changes its opacity: it changes between a colored, translucent state (usually blue) and a transparent state. A burst of electricity is required for changing its opacity, but once the change has been effected, no electricity is needed for maintaining the particular shade which has been reached. Darkening occurs from the edges, moving inward, and is a slow process, ranging from many seconds to several minutes depending on window size. Electrochromic glass provides visibility even in the darkened state and thus preserves visible contact with the outside environment. You may be familiar with electrochromic glass in a small-scale application such as rearview mirrors.

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In indoor application examples, Electrochromic technology is used to protect of objects under the glass of museum display cases and picture frame glass from the damaging effects of the UV and visible wavelengths of artificial light.

- 2. With suspended particle devices (SPDs)**, a thin film laminate of rod-like particles suspended in a fluid is placed between two glass or plastic layers, or attached to one layer. When no voltage is applied, the suspended particles are arranged in random orientations and tend to absorb light, so that the glass panel looks dark (or opaque), blue or in more recent developments, grey or black color. When voltage is applied, the suspended particles align and let light pass.

SPDs can be manually or automatically “tuned” to precisely control the amount of light, glare and heat passing through, reducing the need for air conditioning during the summer months and heating during winter. Other advantages include reduction of buildings' carbon emissions and the elimination of a need for expensive window dressings. This technology has been used in interior and exterior settings for privacy control (for example conference rooms, intensive-care areas, bathroom/shower doors) and as a temporary projection screen.

MagicGlas™ SPD panels use a lamination process which encapsulates a Polymer Dispersed Liquid Crystal Film (PDLC) film between two or more glass sheets. By means of a minute electrical current, users can immediately switch the MagicGlas™ from clear to private (opaque) and vice versa. When the electrical supply is switched on, the liquid crystal molecules align, the panel instantly clears and light passes through. When the power is switched off the liquid crystal molecules are randomly oriented, scattering light, and the panel becomes opaque.

- **Lamination film** is a switchable interlayer film suitable for glass manufacturers and custom applications. This laminated structure provides immense strength that will not shatter when damaged.



Laminated Smart Glass by Glass Apps

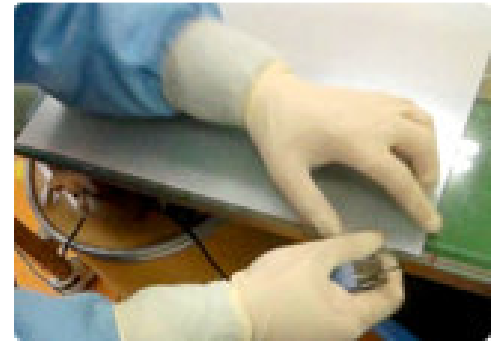


Finished Smart Glass by Glass Apps

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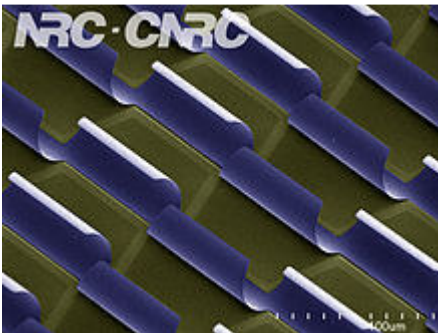
- **Adhesive smart film** can be easily applied to existing glass transforming it into a switchable window, projection screen, or interactive store front display.



Adhesive Smart Glass by Glass Apps

3. Polymer dispersed liquid crystal devices

have dissolved or dispersed liquid crystals into a liquid polymer followed by solidification or curing of the polymer. During the change of the polymer from a liquid to solid, the liquid crystals become incompatible with the solid polymer and form droplets throughout the solid polymer. The curing conditions affect the size of the droplets that in turn affect the final operating properties of the "smart window". Typically, the liquid mix of polymer and liquid crystals is placed between two layers of glass or plastic that includes a thin layer of a transparent, conductive material followed by curing of the polymer, thereby forming the basic sandwich structure of the smart window. When a voltage is switched on, the liquid crystal molecules align, the panel instantly clears and light passes through. When the current is switched off, the result is a translucent, "milky white" appearance. This technology has been used in interior and exterior settings for privacy control (for example conference rooms, intensive-care areas, bathroom/shower doors) and as a temporary projection screen.



Micro-blinds

4. Micro-blinds are currently under development at the National Research Council in Canada. They control the amount of light passing through in response to applied voltage. Micro-blinds are composed of rolled thin metal blinds on glass. They are very small and thus practically invisible to the eye. With no applied voltage, the micro-blinds are rolled and let light pass through. When there is a potential difference between the rolled metal layer and the transparent conductive layer, the

electric field formed between the two electrodes causes the rolled micro-blinds to stretch out and thus block light. The micro-blinds have several advantages including switching speed (milliseconds), UV durability, customized appearance and transmission. To view a video on how this technology works go to

<http://www.youtube.com/watch?v=RqWL2egaqYY>

Critical aspects of smart glass include installation costs, the use of electricity, durability, as well as functional features such as the speed of control, possibilities for dimming, and the degree of transparency of the glass. Interior designers need to connect with a reliable and knowledgeable technical source when specifying Smart glass in all of diverse applications.

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Professional commercial and residential Interior designers must have a basic understanding of technology and the changing times. Supply and demand will continue to bring the new types of glass into the affordable realm for many people. Windows are a major influencer in our interiors whether they connect our clients to the outside, become dividers of interior space or platform into a projection or touch screen. It is the responsibility of the interior designer to stay on the cutting edge of this new technology.

Resources:

Building Products Magazine, October 15, 2011

http://en.wikipedia.org/wiki/Smart_glass

www.andersenwindows.com/A-Series

www.glass-apps.com

www.marvin.com

www.plygemwindows.com/R5

www.prodisplay.com/smart-switchable-glass.html

www.silent-guard.com

www.simonton.com