

# PDLC Glass (Smart Glass Technology)

## Design & Technology Series #21



Fig. 1: Example of Smart Film for Dental Office by Smart Glass Country

### What is Smart Glass Technology

Smart Glass Technology refers to a variety of dynamic glass types that can change optical properties based on external factors. It includes glass that changes tint or transparency with the application of an electric current, or in reaction to solar or thermal changes.

The technology can be classified as either passive or active. Passive technologies react automatically to light or heat to change their optical properties while active technologies use electricity to control transparency or tint with a conductive layer. Examples of passive smart glass include photochromic and thermochromic glass. Examples of active smart glasses include electrochromic, polymer-dispersed liquid crystal (PDLC), polymer network liquid crystal (PNLC) and suspended particle devices smart glass. The topic of this paper is PDLC smart glass.

### How PDLC Glass Works

PDLC smart glass uses a film of liquid crystals positioned between two or more panes of glass (or plastic) to switch between transparent and opaque states. When powered off, the glass, by way of the film, appears opaque; when powered on, it becomes transparent. This is because, when powered off, the liquid crystals are dispersed, scattering light in multiple directions, creating a frosted appearance. When on, an electric charge aligns the crystals, allowing light to pass directly through, resulting in a transparent appearance.

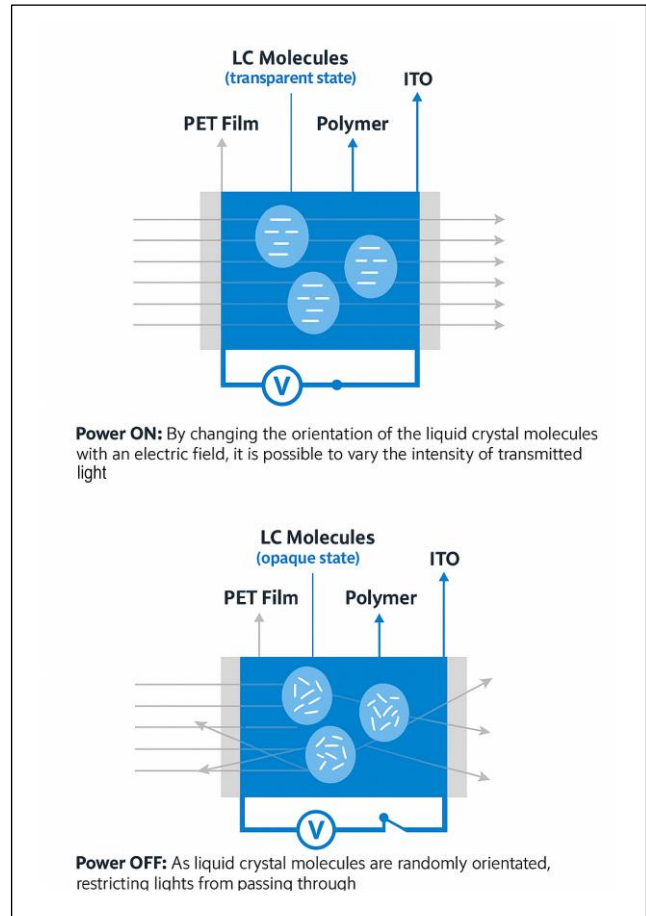


Fig. 2: How Does Switchable PDLC Glass work

### Benefits of PDLC

PDLC is available as both a film and a laminated glass. The PDLC film is a layer that can be adhered to any existing glass wall or window, and cut into any shape, making it an option for retrofit projects. As long as it is connected to a working power source and installed by a knowledgeable professional, it will function as intended. The glass version sandwiches the PDLC film placed between two or more laminated and tempered panes. Both PDLC film and glass have a variety of benefits, which include:

What is PDLC Smart Glass? Smartglass World. (2024, October 8). <https://www.smartglassworld.net/what-is-pdlc-smart-glass>

C., M. (2023, May 18). What is switchable PDLC glass? A comprehensive guide. Switchable PDLC glass | Smart film manufacturer. <https://www.pdlcglass.com/what-is-switchable-pdlc-glass/#:~:text=Switchable%20Electrochromic%20Glass,-.How%20Does%20Switchable%20PDLC%20Glass%20Work?,returns%20to%20its%20frosted%20state>.

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## Privacy and Security

PDLC can transform from slightly opaque to transparent in seconds, allowing nearly instant switching between privacy and visibility. The PDLC smart glass can include built-in soundproofing to mitigate noise transmission. When switched off, increased opacity blocks outside views, and the sticky film can help hold the glass together in case of breakage.

## Manageable Operation

PDLC can be controlled via a remote, wall switch, smart phone, voice command, sensors, automated systems, and more.

## Multipurpose

When in its frosted state, the glass can double as a projection screen or white board.

## Sustainability

The PDLC film can still allow 2-65% light to pass through in its most opaque state, depending on dye formulations. So, it has the potential to reduce artificial lighting requirements and its associated energy use. Moreover, it blocks approximately 95-99% of UV rays, helping to reduce solar heat gain and heat loss.

## Hygiene

When compared to textiles materials like blinds, PDLC smart glass can be a more hygienic alternative for privacy. It is easier to clean than blinds or curtains due to its smooth surface. The adhered film can also be cleaned easily with a soft cloth and mild cleaning solutions. However, harsh chemicals should be avoided to prevent damage.

## Considerations

As with any emerging technologies, there are many considerations to take into account when considering their application. These can include:

### Cost

There are both upfront and operating costs associated with PDLC smart film and glass. PDLC smart glass typically costs \$80-\$150 per square foot. The PDLC film, though not protected by glass, is less expensive at an approximate rate of \$25-\$70 per square foot. This does not include additional accessories to conceal the wires if the design does not account for them.

Maintaining transparency requires a constant electric charge of about 5 watts per square metre to keep the liquid crystal aligned. While low individually, large quantities or long-term use can add up.

## Energy Consumption

Although PDLC can reduce lighting and heating/cooling demands, it still uses electricity to function. For this reason, clients who prefer the transparent state most of the time may consider PNLC smart glass, which has the inverse function to PDLC smart glass.

## Maintenance

It should be considered that the usage is not infinite; there is a limit to the “powered-on” hours. This gives the film an approximate lifespan of 15 to 20 years, but can be shortened by damage, which includes physical damage, moisture exposure, or extreme cold.

When used as the adhered film on existing glass, PDLC film is exposed and thus vulnerable to physical and moisture damage, as well as discoloration or re-lamination.

Another form of damage could occur if the PDLC smart glass or film is exposed to cold. Freezing temperatures can prevent crystal movement temporarily, while prolonged freezing can lead to permanent damage.

## Potential Applications



Fig. 3: Example from Smart-Film™ Smart Film Product Video

Given Alberta's extreme winter climate, PDLC smart glass may not be ideal for exterior windows. However, with its privacy and security features, it could be effective for interior glass surfaces. As not to worry about over consumption, it could offer a solution to spaces that regularly alternate between privacy and openness, but that also require enhanced hygiene, like hospitals.

C., M. (2024, March 12). 10 modern ways to control PDLC glass and. Switchable PDLC glass | Smart film manufacturer. <https://www.pdlcglass.com/10-modern-ways-to-control-pdlc-glass-and-film/#:-:text=Simply%20connect%20the%20transformer%20to,the%20PDLC%20glass%20from%20anywhere.>

Costing reference by Smart Film Inc (\$150 per square foot)

Maxim, D. (2018, July 27). The truth about smart glass and film. Smart Glass for Residential and Commercial Applications, Smart Glass Country. <https://www.smartglasscountry.com/news/the-truth-about-smart-glass-and-film>

Maxim, D. (2018b, July 27). What is PNLC reverse film? Understanding its technology and applications. Smart Glass for Residential and Commercial Applications, Smart Glass Country. <https://www.smartglasscountry.com/news/pnlc-reverse-film>

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