Dispensing Photochromic Lenses

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From café variables to photochromics … we've come a long way (*baby)*. Once used for the practical purposes of one pair only, today's variable tinted lenses fit in with lifestyle dispensing and multiple pairs. Who wouldn't want eyewear that provides both practical function and fashion fun? Because of current technologies available to us, our clients can have a clear-to-gray/brown option for comfort and protection *and* pink-to-purple lenses for style on the go.

The first photochromics were introduced in the mid 1960s with the invention of Corning's PhotoGray lenses. This was a major breakthrough in lens technology and gained popularity very quickly. My first introduction to photochromic lenses was in the late 1970s, available in a glass material only.

At that time, it was the mainstream photochromic material used and worked well overall. As we began shifting our choice in lens material from glass to plastic, however, the percentage of photochromics dispensed started to decline. There was a market for plastic photochromic lenses, but the technology had not been developed yet. Many clients remained in glass lenses longer and resisted CR-39 plastic simply because they wanted to keep their photochromic lenses, and, early on, CR-39 photochromics had some major pitfalls.

Rodenstock first introduced plastic photochromic lenses to the U.S. market in the early 1980s. They were called "Jewel Tones" and were bright pink, purple, green and blue. Although they were attractive in color tone, they did not fulfill the requirements of a sun lens nor did they capture the market. While we desired the lightweight comfort of plastic photochromics, we needed the function and protection of a full sun lens. Evidently we were not quite ready for the fashion and fun of changeable café tints.

Today's photochromic technology increases visual comfort as well as contrast sensitivity, which is good news for society as well as the optical industry.

Transitions Optical introduced and commercialized plastic photochromic lenses in 1991. Through its patented imbibing process, photochromic dye was applied to the front surface of the lens and then processed so that it penetrated into the plastic. This new technology opened the doors for plastic photochromic lenses, as the speed of the darkening/lightening process was improved, and the lenses became darker than the early plastic photochromics. Throughout the 1990s and today, additional optical companies have introduced plastic photochromic lenses. These include clear, sunwear and fun color options, e.g., pink to purple and blue to green.

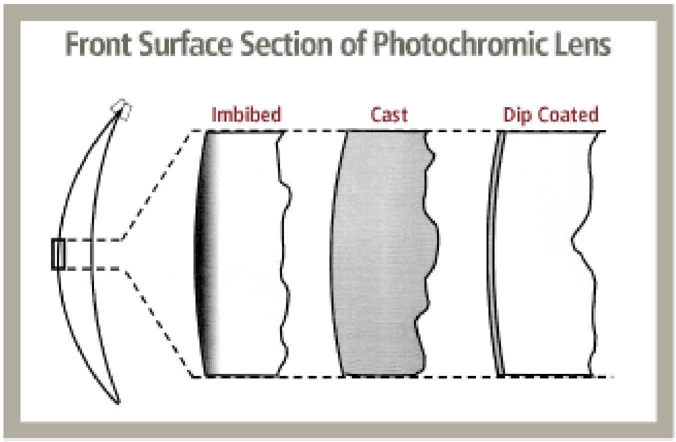
This improved photochromic technology enhances vision. But how do we get this good news to the general public? Sometimes our clientele resists purchasing changeable plastic lenses because they remember early technology that did not work as well. This could lead to making decisions in regard to their visual comfort based on old information. It is our job to educate them in technological advancements and to let them know what is available today.

To begin, we'll do an overview of today's photochromic technology. How do photochromics work? We know that ultraviolet light changes the lens from light to dark. Specifically, UV radiation of wavelengths between 300 and 400 nanometers darkens the lens, and the absence of UV (under 300 nm) lightens the lens. The process by which they change depends on the material and the technology.

Glass, for example, is made in *molten* state, with *silver halide crystal* added to the mix. That is, in its heated liquid form, the crystals are added, yielding a uniform density throughout the material. The problem, however, is that high plus and high minus lenses will show a bull's eye or raccoon effect because of the thickness and density of the lens in certain areas. The thicker part of the lens will be darker, while the thinner part of the lens will remain relatively light in color. This is because plus lenses are thicker centrally, and minus lenses are thicker at the edges, peripherally.

Early plastic photochromics were made using molecular photons through a process known as *indolinospironaphthoxazine (ISN).* When the ISN molecule absorbs UV light, its bond breaks and half of it rotates, creating a new form in which visible light is absorbed. Then, in the absence of UV (i.e., lower light levels), the molecules return to their original state, and the lens fades back to clear.

Today's plastic photochromic lenses are created through processes known as *imbibition* and *in-mass* technology.



With *imbibition*, the photochromic compounds are driven into the front surface of the lens. Unlike a thin coating that can be scratched off, the photochromics are permanently embedded into the lens surface. Because the photochromic compounds become part of the lens, the color will be uniform in density. The key is that the layer that causes the color change is uniform as well. We are now able to get darker results because of the depth and thickness of the layer. For example, imbibition is 50 times deeper than a scratch resistant coating.

In-mass technology is similar to the manufacturing techniques used for glass, but with *monomer*, plastic in its liquid form. In this case, photochromic molecules are distributed throughout the material, rather than only on the surface of the lens. While this technology is fine for low prescriptions, the bull's eye and raccoon effect may result with higher powered prescriptions. Similar to mixing crystal halide crystals in molten glass, in the case of plastic, the photochromic compounds are mixed into the monomer. The mixture is then poured into the mold, and the lens is processed and cured. The same density/lens thickness factors that exist for glass lenses will apply here as well.

Factors That Affect the Amount of Color Change in Photochromics

Various factors affect photochromic lens performance. They include solar radiation and thermal energy, latitude, altitude, season and time of day. Also, the orientation of the lens will affect how much available UV light is reaching the front surface of the lens. If the wearer is looking up at the sun, for example, more UV will reach the lens than if the wearer is looking parallel to the ground. When we compare products, it is important to think of all of the factors under which the lenses will be worn. Let's examine each factor individually.

Solar Radiation and Thermal Energy

Ultraviolet light (wavelengths between 300 and 400 nm) will cause a photochromic lens to darken. The amount of darkening of a photochromic material is partially dependent on temperature. That is, the lens will darken more in cold temperatures than in hot.

Darkening will occur far more quickly under a clear blue sky than in overcast conditions or inside a car. So, in essence, the lens will be its darkest on cold, bright days. The type of radiation that activates the change to a dark color is within the UVA and blue region of the visible spectrum. A condition where there is a large amount of UVA waveband is at high altitudes.

The lens will get darker in higher altitudes. A bright, sunny winter day skiing on a mountain in very cold temperatures will yield the darkest lens possible. Solar radiation will also vary with time of day, with the highest amount of UV light at high noon. Many photochromic lenses block 100% UVA and UVB radiation in the clear and darkened states, adding to the protection of the eye.

Lens Thickness/History of Previous Cycles

The thickness of the lens makes a difference in glass photochromics and in plastics using in-mass technology for processing. The thicker the lens, the greater the density of the photochromic compound in the material.

While glass photochromics darken more with continued use, they don't fade back after a while and leave the wearer with a permanent indoor tint. Plastic photochromics have a lifespan that varies with use. In the case of the plastics, the more the lens is exposed to UV light, the faster it will "wear out," shortening the lifetime of the photochromic performance.

Certainly, the changeability should last the life of a normal prescription cycle. The Transitions lens boasts a lifespan of 2-½ years for its lens—and then it's not that it stops working, it just won't get as dark.

Photochromic Lenses and Glare

Many people suffer from uncomfortable vision due to excessive glare. Strictly defined, glare is the loss of visual performance or visibility produced by a luminance in the visual field greater than the illuminance to which the eyes are adapted. That is, visual acuity and comfort are sacrificed because of glaring conditions of light in the visual field.

Glare has more than a dozen categories and definitions in lighting engineering, but there are just four we need to know about for eyeglasses and eyesight. The source of the light as well as its intensity define glare.

- ***Distracting Glare*** - A minor annoyance caused by lens surface reflections that lead to eye fatigue.
- ***Discomforting glare*** is glare at a level of annoyance or inconvenience that causes squinting or eye fatigue.
- ***Disabling glare*** is glare strong enough to block vision and reduce contrast of the retinal image.
- ***Blinding Glare*** - Completely blocks vision and is caused by light reflected off smooth, shiny surfaces such as water or sand.

Common sources of glare include intense ambient light, reflective glare from headlights of oncoming traffic or street lights at night, refracted glare-light reflected off the front and back surfaces of the lenses and specular reflections. We know that the best optical solution to glare is to add anti-reflective coatings, and it is no different with photochromic lenses.

While photochromic lenses will alleviate visual stress and add comfort to all lighting conditions, AR coating is still the best way to deal with glare. Fortunately, photochromic lenses are completely compatible with AR coatings. Some dispensers are still working under the misconception that coating a lens with AR will somehow inhibit the lens from changing.

Today's photochromic lenses change regardless of the presence of anti-reflective coatings. In fact, adding AR to photochromic lenses will increase the performance of the lens in regard to glare and will provide greater visual comfort to the wearer. Studies show that with the addition of anti-reflective coatings, the bleached transmittance will be up to 6% higher, while the darkened transmission and fade rate are virtually the same.

So, don't skimp on this important premium option. Your clients will thank you for it later.

Features and Benefits of Today's Photochromic Lenses

A great way to explain optical options to our clients is by creating a Features and Benefits list, or ***FAB list***:

FEATURE	***BENEFIT***
Darken in bright light and lighten in low light	Offer comfort in various lighting conditions, providing protection for photophobic patients
Provide 100% UV protection	Protection from UV light (a leading risk factor in cataract development & macular degeneration)
Contain photosensitive molecules within the lens material	Provide uniform tint and performance across the lens regardless of thickness
Compatible with anti-reflective coating	Increase indoor light transmission by as much as 6% for clearest possible vision
Available in gray, brown and fashion-forward colors like pink, purple, blue and yellow	Offer variety of options for both practical function and fashionable style
Available in standard plastic, mid and high index, polycarbonate and Trivex	Clear, thin lightweight lenses for a variety of prescription ranges
Available in single vision, bifocal, trifocal and progressive styles	Patients can add photochromic options without changing their preferred style of lens

Promoting Photochromic Lenses

As optical professionals, we know the value of adding visual comfort and protection by using photochromic lenses. Getting the word out, however, is not so simple.

The most common motivation for patients to purchase a photochromic option is the convenience of having one pair of eyewear. If photochromic lenses were marketed more aggressively, it is highly likely that more consumers would purchase this option. Showing our clients the actual lenses in and out of sunlight is the best marketing approach.

One example is to place a sticker (like a blocker tape) in the center of a lens blank and take the lens outside. Then, after it darkens, peel off the sticker so the client can see the "before" and "after" in the same lens. Another idea is to create a pair of glasses with one lens tinted to a Gray III (80 to 85% dark) and the other lens in the photochromic you are offering.

Then, send the client outside wearing the sample to compare, side by side, the efficacy of the variable tint. This works equally well when they re-enter the store to see the lens fade back to its clear state.

These samples can also be made using fashion-forward colored photochromics in pink, purple, blue and yellow. Displayed with fabric or fashion magazines will communicate the fashion and multiple pairs message to your clientele.

Explaining Photochromics to Our Patients

When explaining lens options to patients, I still go by the old adage, KISS (Keep it simple, sweetheart!). In the past, we explained all kinds of ways to enhance performance of photochromic changeability, including placing the lenses in the refrigerator! While temperature does have an effect on the overall performance of the lens, placing it in a refrigerator is an unnecessary step.

Photochromic Do's and Don'ts

Because of new and ever-changing lens technologies, the "word out" on photochromic advancements can be about as clear as mud. As dispensers of ophthalmic products, it is important that we keep ourselves up to date in regard to scientifically proven lens advancements and to keep old wives' tales about lenses out of our conversations with our clients. For example, when photochromics first came out, they performed just as well behind our car windshields as they did outside in sunlight.

This was not due to advancements in photochromic technologies, but was due to the simple fact that car windshields did not absorb UV radiation as they do today. I attended a seminar on photochromics at which the speaker gave a great analogy in regard to photochromic lenses (not) changing behind a car windshield.

She took us down memory lane, back when our car windshields did not absorb ultraviolet light. She reminded us that we used to have to completely replace our dashboards and interiors due to damage from UV radiation. She noted that in today's standards, it would be unheard of to have to replace your entire dashboard and leather interior because of UV damage.

Then, she asked us to compare total costs:

A) Have a second pair of prescription sunglasses for driving and keep UV protection in our windshields, thus expanding the lifetime of our car's interior.

B) Stay with just one pair of prescription eyewear and *not* have UV absorption in our car windshield, therefore having to replace our damaged dashboards and leather interiors, because our windshield allowed the UV light to penetrate into our car.

So, you do the math … One extra pair of prescription sunglasses for driving, or a new interior for your car … When presented this way, the car/windshield issue does not seem as important.

When in Doubt: Educate, Educate, Educate …

What our clients/patients really need is education and instruction as to what to expect from their photochromic lenses. *Glamour* magazine has been very successful creating a "Do's and Don'ts" fashion list. Let's create our own list for photochromic lenses:

Do Tell Your Patients:	***Don't Tell Your Patients:***
Photochromics will darken to a sunglass density outside in direct sunlight.	Photochromics will darken to sunglass density behind a car windshield.
Photochromics have a "break-in period," and the more exposure to sunlight at the beginning, the better the overall performance.	Photochromics need to be "broken in" by placing them in a window for direct light exposure or a refrigerator for exposure to cold temperatures.
Photochromics are available in many materials and lens styles.	Photochromics are limited in availability.
Photochromics are completely compatible with anti-reflective coatings.	Anti-reflective coatings will inhibit the changeability of the lens.
Photochromics are completely compatible with scratch resistant coatings as well as tints and mirror coats. *(They really can have it all!)*	They have to choose between premium lens treatments.

Whether for function and protection, or fashion and fun, the availability of today's photochromic lenses provide optical solutions to our clients' visual *wants* and *needs.* My personal optical motto is "I cannot rest until everyone has at least four pairs." Given today's premium photochromic options, this motto can become a reality.