

Photochromic Lenses

Neochromes® Light Activated Lenses

**Differentiation through
value-added products**



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Photochromic lenses are under 20% of the lenses dispensed but contain close to 50% of the value. It is part of IOT's mission to provide our partners with an **independent solution** for this very important value-added category.

New IOT Neochromes® light activated lenses include the **latest technology**, so the lenses are of the **highest quality**. This allows our partners to successfully **compete with market leaders, with no compromise in performance.**

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Daniel Crespo, IOT President



Two recently merged seed businesses control **over 50%**
of the seed supply, not just in the US, but **globally**.



The impact of **consolidation**

Consolidation has played a **major role in re-shaping the business landscape in many areas**. A mere 6 companies, control 90% of everything we read, watch and listen to in the US. Two recently merged seed businesses control over 50% of the seed supply, not just in the US, but globally. In the US pharmaceutical industry, one company has 90% of the market share for lifesaving epinephrine injecting devices. They have used this position to thwart competition and dramatically raise prices. The cost of a single injector has increased over 600%, from \$47 to \$350, since 2007.

Soaring costs aren't the only reason to be concerned about consolidation. Experts warn that it leads to **lack of competition** which paves the way for the **loss of expertise within an industry**. This happens when small, mid-size and local businesses close and there are fewer industry jobs due to global outsourcing. In addition, consolidation can result in a **dramatic decline in innovation, harmful supply contracts, and lack of price transparency**. As industries become more consolidated the true price of a product is often obscured by complex structures that include kickbacks and rebates.

In the ophthalmic optics industry, a few global giants make the majority of eyeglass lenses sold to consumers. As these giants have grown, they have moved beyond consolidation of lens manufacturing to more vertical integration strategies. This integration has led to unusual business situations in which it is not uncommon for **industry suppliers to openly compete with their own customers, in the same markets and with the same products**.

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For consumers, **eyecare is complex**

Optical industry consolidation has not simplified the eyeglass purchase process for consumers. From their perspective, eyecare can be quite complex. After an eye examination, patients are given a prescription, but unlike an Rx for a drug, an eyeglass **prescription leads to complex decisions** about materials, coatings, and lens designs. Consumers themselves **don't have the background necessary to make educated decisions** on what to purchase. They have no way to determine the quality or value of their finished eyewear. Eyecare consumers are almost entirely **dependent on the advice they receive from eyecare professionals**. It is up to us to give them the best solutions for their unique visual needs. It is also up to us to make sure we are running a strong and healthy business. In this environment of industry consolidation and integration, providing **top-quality products, differentiation and a good value for our consumers is critically important to our future.**

// It is up to us to give them the best solutions for their visual needs. It is also up to us to make sure we are running a strong and healthy business. **//**



Differentiation through value-added products

The strategic use of differentiated value-added products from independent suppliers

One of the best ways to provide eyecare consumers with high quality and value is through the **strategic use of unique products from independent suppliers**. Recent optical industry consolidation has led to a market in which actual consumer choice is becoming more limited while the process of purchasing a pair of eyeglasses is becoming more complex. The result can be an uncomfortable experience in which a consumer feels they are “being sold” something they don’t need and cannot understand. Consumers can understand and **benefit from value-added products**, products with features consumers see as desirable and are willing to pay more for.

Value-added products are also one key to maintaining strong businesses because they contribute to overall profitability. In many value-added categories within optical, like AR coatings, progressive or photochromic lenses, there may only be one dominant brand that is widely distributed, available almost everywhere and advertised directly to consumers. This model of branding comes at a cost. These products are often the most expensive and may not be the highest quality or most innovative. This creates an opportunity for today’s independent optical retailers to **truly differentiate** themselves through their product offerings.



When it comes to product differentiation, consumer perception is key

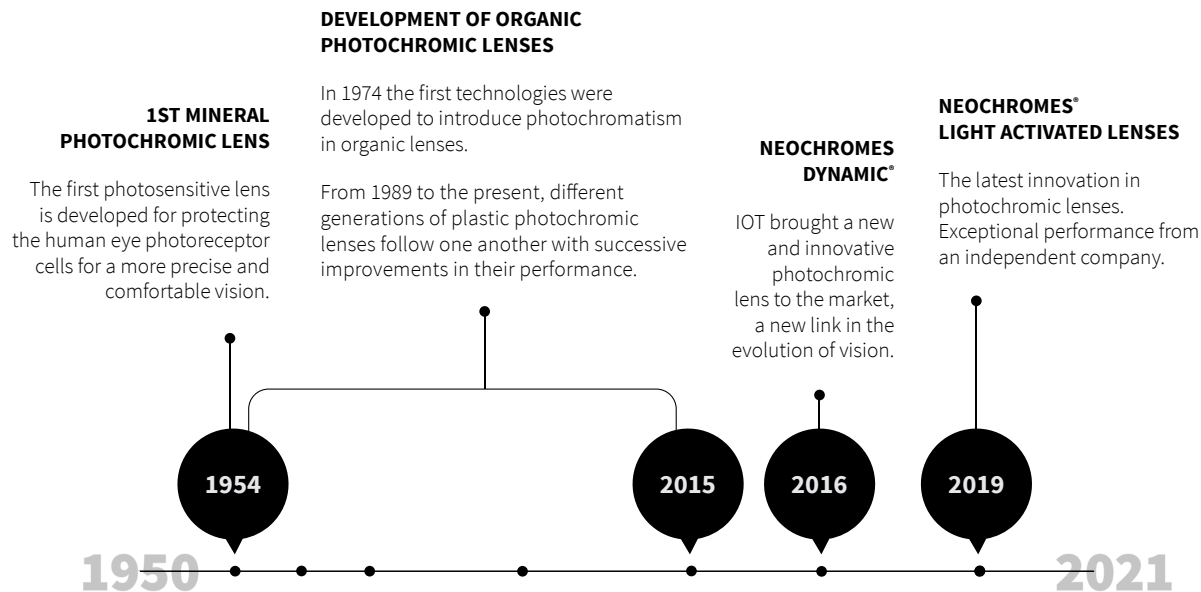
Grocery stores with successful product differentiation strategies have proven consumers will go out of their way to purchase products they perceive as superior. In fact, 36% of grocery shoppers say they are likely to make a special trip to buy private label items from their primary retailer. These **customers report being more satisfied** with their purchases and more loyal to the store. They perceive a **unique product experience** that other grocers cannot easily duplicate.

One of the most visible lens products offered to eyeglass wearers are photochromic lenses. Eyecare consumers can easily see what makes a photochromic lens different from a standard clear lens and many are prepared to pay more for lenses that increase comfort by darkening in bright sunlight. It is in categories like this that a **unique product offering can help you differentiate your business**, especially one with performance that can easily be demonstrated to consumers.

Introducing **Neochromes** light activated lenses

When IOT entered the digital progressive lens design market, there were many branded progressive designs, but they tended to have limited options and offered similar features. IOT introduced unique products with complete flexibility, a broad offering and a straightforward pricing strategy that allowed our partners room for healthy margins.

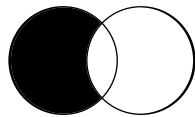
IOT's path of innovation for value-added products now includes Neochromes light activated lenses. A new line of **highest quality photochromic lenses** with performance characteristics designed to help IOT partners differentiate their businesses with **products consumers will perceive as superior** to other, more broadly available photochromic lens offerings.



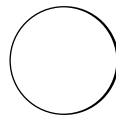
Consumer **benefits** **of Neochromes** light activated lenses¹



Dark in
seconds²



3-minute
fade-back³



Crystal clear
indoors⁴

The stated benefits of new Neochromes lenses were **designed to be easy for an eyecare provider to demonstrate and for an eyecare consumer to understand**. They don't rely on comparisons to other products the consumer may or may not be familiar with. They allow eyecare providers **to quickly and easily answer the most common questions**.



Q: What do they look like indoors?

A: **They look crystal clear.**

Q: How quickly do they darken?

A: **They darken in seconds.**

Q: How long do they take to fade back indoors?

A: **At standard room temperature they fade back in less than 3 minutes.**

¹. Measured at 555nm at 23C using ISO 8980-3: 2013/ ANSI Z80.3 2015. | ². t1/2D is 5 seconds. | ³. t1/2F is 140 seconds. | ⁴. 85%T in inactivated state.

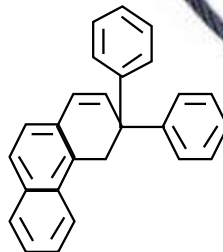
The **key** is new **high-performance** photochromic dyes

The unique benefits of new Neochromes light activated lenses are made possible by the development of new-to-the-world, high-performance photochromic dyes. **Photochromic dye molecules use energy from UV light to trigger an equilibrium reaction to change from a closed, “transparent” shape to an open, light-absorbing, “dark” shape.**

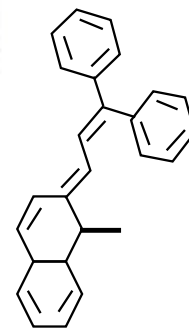
The two forms of the photochromic **molecule, open and closed, exist in equilibrium, with a bond continually breaking and re-forming, as the dye molecules change back and forth between their transparent and dark states.** The number of molecules in the dark state, thus the darkness of the lens, depends on how much UV light is in the environment and other factors such as temperature. If the lens is exposed to significant levels of UV light, most molecules will be in the open state, making the lens very dark. In the absence of UV light, molecules will stay closed, resulting in a transparent lens.

In creating Neochromes light activated lenses, **the equilibrium reaction was pushed toward the light-absorbing form of the molecule as much as possible when UV light is present to achieve desirable darkness in seconds**, and for the reaction to reverse **back to the clear** form of the molecule **within 3 minutes** when the wearer returns indoors.

Photochromic dye molecules change from a closed **(transparent)** shape...



...to an open, light-absorbing **(dark)** shape when exposed to UV light.



Protection from **harmful UV and blue light**

UV light blocking

UV light is generally defined as invisible light with wavelengths between 100-380 nanometers (nm). UV light has much higher energy levels than visible light. Exposure to UV light can cause changes in the skin, leading to suntan, sunburn, wrinkles, and potentially skin cancer. The cornea and lens of the adult human eye are quite efficient at blocking UV radiation and keeping it from reaching the retina. However, **UV light damages the skin and front structures of the eye**. Prolonged exposure to UV light is linked to pterygium, photokeratitis (snow blindness), cataracts and other eye maladies. **Neochromes lenses block 100% of UVA and UVB light** up to 400 nm.

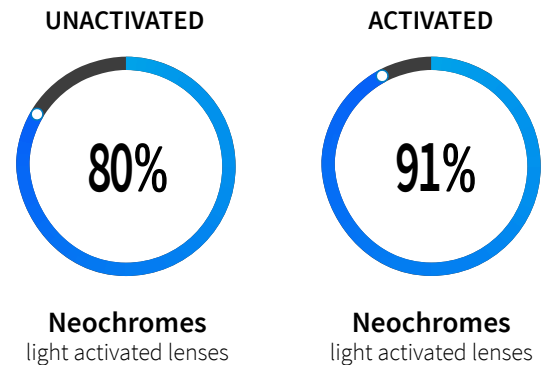
Blue light filtering

Blue light is the portion of the visible light spectrum with the highest energy, usually considered to be wavelengths in the range of 400-500 nm. **Sunlight is by far the largest source of blue light** in our environment. The display screens of our computers, phones and other digital devices are also sources of blue light.

Neochromes lenses offer protection against these harmful wavelengths of light. Neochromes lenses in gray block an average of 80% of high energy light (400-420 nm) when clear, and at least 91% of high-energy light when dark. In addition, they block an average of 89% of light between 425-450 nm when dark.

Blue light filtering

Absorption (400 nm - 420 nm)



How to analyze photochromic lens performance

An introduction to kinetic charts

Neochromes lenses are crystal clear indoors, darken in seconds and fade from dark to clear in less than 3 minutes. To visualize how this contributes to a better experience for the wearer, we study the photochromic cycle in the form of a kinetics chart.

Kinetics charts map the photochromic performance as the lens goes from clear to dark and back again. Darkness or % transmission is on the vertical axis. On the horizontal axis we move over time from the initial transparent state, UV exposure, and darkening, and finally removal of UV light and fade-back to the transparent state.

Kinetics charts show four phases of photochromic lens activation

1. The Clear Stage

Before UV exposure the lens is in its most transparent state. Residual color comparisons can be made during this stage. The higher up on the vertical axis the curve starts, the clearer the lens appears indoors.

2. The Darkening Stage

When the lens is first exposed to UV light, the photochromic molecules begin to change from the clear to dark. A steep slope downward indicates fast activation.

3. The Dark Stage

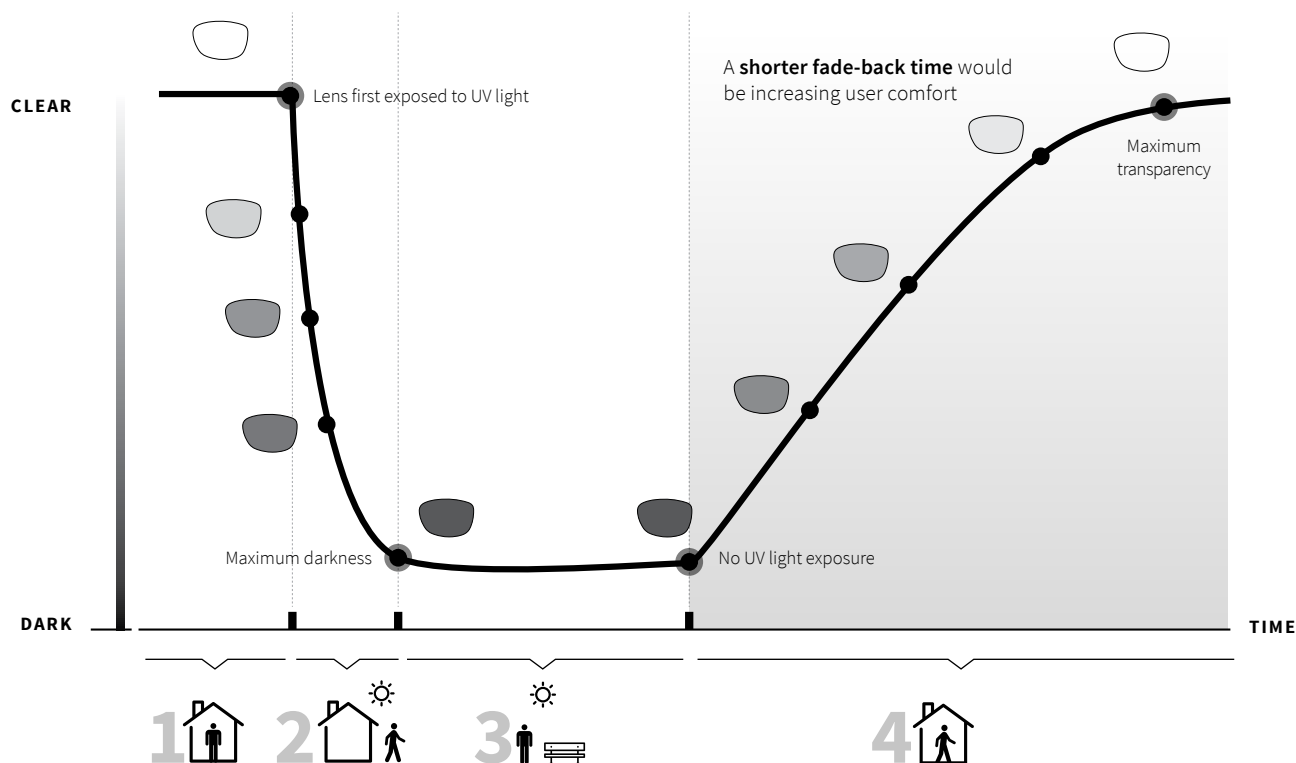
Lenses are at peak activation. Light transmission, activated color, and color uniformity can be assessed at this state.

4. The Fade-Back Stage

Fast fade-back is critical for user comfort. It begins when UV light is removed. A steep curve upwards indicates a faster feed-back speed. The shorter the fade-back, the more comfortable and functional the lens is to the user.

As you can see based on the kinetics chart for Neochromes polycarbonate lenses; at room temperature, Neochromes lenses **start out looking crystal clear**, with 85% light transmittance, similar to clear high index materials. Light transmission can increase significantly with the application of high quality, low reflectance AR coating. They also **darken in seconds** with a $t_{1/2D}$, or the time to achieve half their darkness, of 6 seconds. As for fade-back speed, the $t_{1/2F}$ of Neochromes polycarbonate lenses, or the time to fade-back half way, is 132 seconds, a little over 2 minutes. At room temperature, when worn on the face, they will appear to be **fully light in 3 minutes or less**.

Timeline of photochromic lens wear (Kinetics chart)

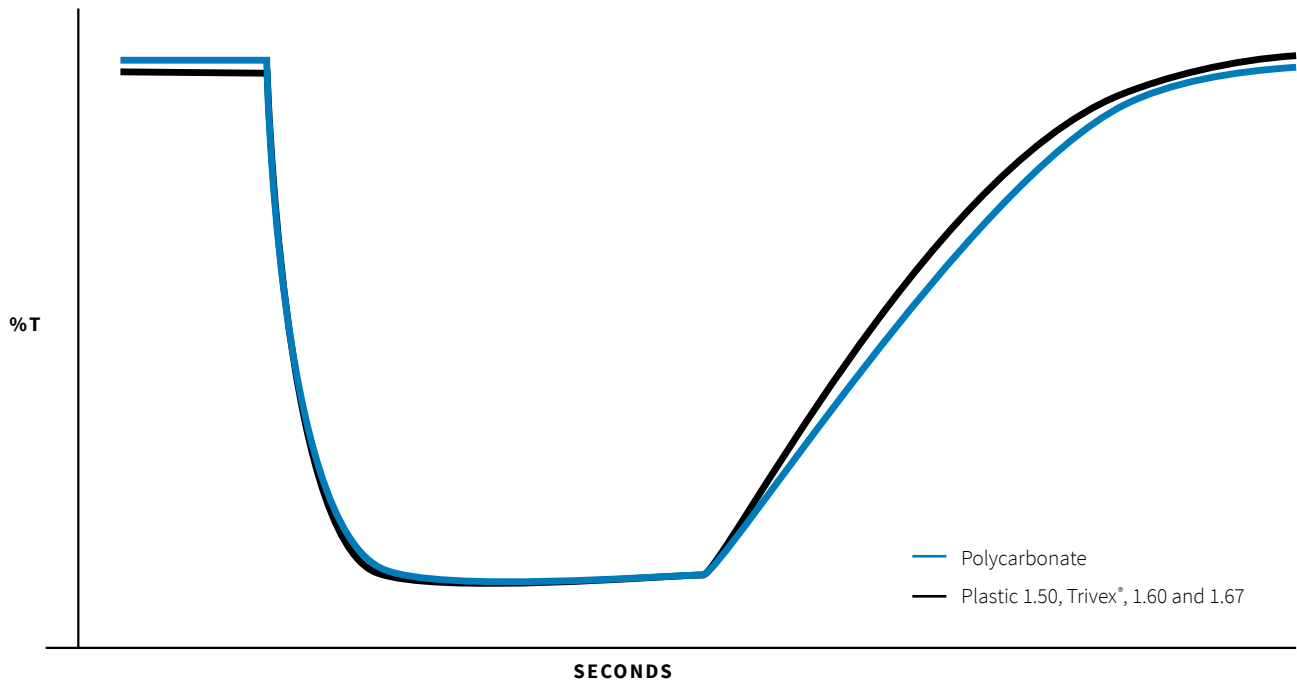


Consistency of performance

Materials

It is not unusual for photochromic lenses to **perform differently in different materials**. This is because manufacturing methods and sometimes even the dyes themselves are different. As you can see in the kinetics chart below, performance across materials is virtually identical. **These lenses will perform consistently for your patients** even if they choose a polycarbonate lens for sports and a 1.67 for dress eyewear.

Darkening/Fading (Kinetics chart)



Temperatures

All photochromic lenses perform differently at different temperatures. In colder temperatures, photochromic lenses get darker and take longer to fade back. In warmer temperatures, photochromic lenses don't get as dark and fade back to clear even faster. This is another characteristic of the photochromic equilibrium reaction. Photochromic molecules use the energy from heat to return to their transparent state.

Special attention was paid to the high-temperature performance of Neochromes lenses. In hot temperatures, 33°C (around 91°F), Neochromes lenses will reach functional darkness, around 17% luminous transmittance, similar to many polarized sunglasses. At this temperature $t_{1/2F}$ is around 32 seconds.



**WARMER
CLIMATE**

– Darkness
+ Fade-back speed



**COLDER
CLIMATE**

+ Darkness
– Fade-back speed



Differentiation through **service**

The services provided by IOT are unmatched

In today's world of global production, true differentiation requires more than innovative products, it also requires reliably great service. To provide the best possible service, IOT made the decision to **onshore production** and bring their research and manufacturing teams together in one place. The high-performance photochromic dyes utilized in Neochromes lenses are applied at their newly created **manufacturing center in the USA**⁵.

In addition, IOT's innovations have always been accompanied by a **wide range of services** that help their business partners manufacture the best lenses in the world. Support provided by IOT includes technical expertise, on-site training, and customized marketing materials. These services make it easier for IOT partners to **differentiate themselves with top quality value-added lenses**.



⁵ 1.50 plastic, 1.60, 1.67 and Trivex. The Neochromes high performance photochromic dyes are applied in the USA at IOT's manufacturing facility. Lenses are inspected to the highest quality standards, packaged and shipped to your laboratory (USA, Canada and LATAM versions) 1.50 plastic, 1.60, 1.67 and Trivex.

Neochromes

lens availability

Neochromes, optimum performance in all materials

MATERIAL	COLOR	DIAMETER	BASE CURVE
PLASTIC 1.50	GRAY & BROWN	76	1.25 / 2.25 / 3.25 / 4.25 / 5.25 / 6.25 / 7.25 / 8.25
TRIVEX®	GRAY & BROWN	70* / 75	1.00* / 2.50 / 4.00 / 5.00 / 6.00 / 7.00 / 8.00
POLYCARBONATE	GRAY & BROWN	76	0.50 / 1.25 / 2.25 / 3.25 / 4.25 / 5.25 / 6.25 / 7.25 / 8.25
HI-INDEX 1.60	GRAY & BROWN	73	0.50 / 1.00 / 2.00 / 3.00 / 4.00 / 5.00 / 6.00 / 7.00 / 8.00
HI-INDEX 1.67	GRAY & BROWN	75	1.00 / 2.50 / 4.00 / 5.00 / 6.00 / 7.00 / 8.00

Neochromes

Light Activated Lenses

Exceptional performance from
an independent company.

Photochromic Lenses

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