

LUXEON CoB with CrispWhite Technology

Delivering brilliant white and great color rendering performance for retail merchandise



Introduction

What do major retailers desire in their stores? They want merchandise to appear attractive and inviting to potential customers. LUXEON CoB with CrispWhite Technology, a new LED alternative to conventional lighting technologies, offers a single LED light source which makes whites appear more vibrant and colors look warmer and richer.

LUXEON CoB with CrispWhite Technology is the optimal choice for retail lighting because:

1. In contrast to other lighting solutions, LUXEON CoB with CrispWhite Technology activates Fluorescent Whitening Agent (FWAs) in merchandise, providing the brilliant white effect retailers desire.
2. LUXEON CoB with CrispWhite Technology offers great color rendering performance. The typical CRI_{Ra} value is over 90 and the typical CRI_{R9} value is over 50, resulting in rich red and warm colors.
3. LUXEON CoB with CrispWhite Technology contains an additional (deeper) blue peak in the spectrum with negligible spectral content below 400nm.
4. Compared to traditional light sources, merchandise is less prone to fading when illuminated by LUXEON CoB with CrispWhite Technology.

This latest innovation gives retailers the lighting they need to attract and retain customers.

How Does LUXEON CoB with CrispWhite Technology Work?

When illuminated by daylight, untreated white items, such as fabrics made from natural fibers, tend to appear yellow or ivory to the naked eye. These fibers absorb the blue content of incident white light, resulting in a reflected light that appears yellowish.

Designers incorporate Fluorescent Whitening Agents (FWAs) into dyes, inks and even laundry detergent to brighten fabrics. These agents absorb photons with wavelengths in the near ultraviolet, violet and deep blue spectrum, which are difficult for the human eye to see. The energy of the absorbed photons is re-emitted by the fabric in the form of photons with longer wavelengths, typically in the blue spectrum (Figure 1). By incorporating FWAs into fabrics, designers can compensate for the natural deficiency of the blue spectral content in reflected light from white fabrics.

Unlike most traditional LED light sources, LUXEON CoB with CrispWhite Technology is specifically designed to provide more light in the deep blue spectrum to activate the fluorescent whitening agents found in nearly all clothing, fabrics, and paints.

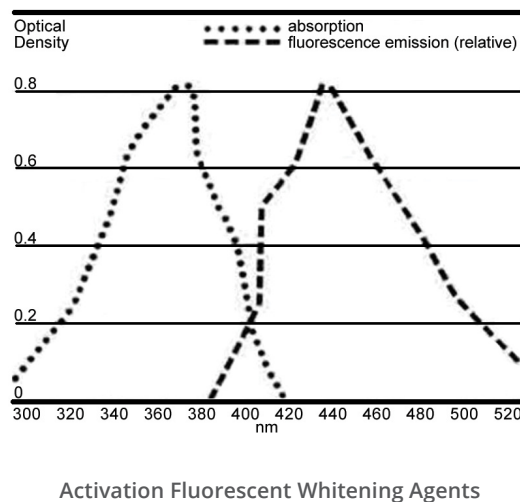


Figure 1. Absorption and emission behavior of a typical Fluorescent Whitening Agent (FWA) from Benetex® OB Plus Optical Brightener, Fluorescent Whitening Agent July 2, 2010.

Blue Shift

When exposed to the correct spectrum of short wavelength light, items treated with FWA emit enough blue light to compensate for their original yellowish appearance and make the item look crisp white. Lumileds performed perceptual studies to determine the ideal level of blue shift required to provide a perception of crisp white without a noticeable perception of blue tint. The perceived color point in CIE u' , v' space is shifted downwards in v' by 6 to 8 points compared to its measured color point.

White perception studies, performed at the Lighting Research Center at Rensselaer Polytechnic Institute (2010), determined that viewers recognize a color point shifted well below the Planckian black body radiation curve for warm white Correlated Color Temperatures (CCT) as “most white” (Figure 2). This color point is outside the ANSI specification for luminaires with a nominal CCT of 3000K. Rensselaer suggests that these results on color perception are especially relevant for commercial environments.

LUXEON CoB with CrispWhite Technology has a nominal CCT of 3000K to ensure a warm inviting environment similar to traditional halogen lamps. However, the actual color point is targeted below the Planckian black body radiation curve but still within the ANSI specification for a nominal CCT of 3000K. The additional blue shift from any FWAs pushes the color point of treated objects down towards the optimal white point. This color point is very similar to Ceramic Metal Halide (CDM) lamps that are currently widely adopted in commercial (retail) environments.

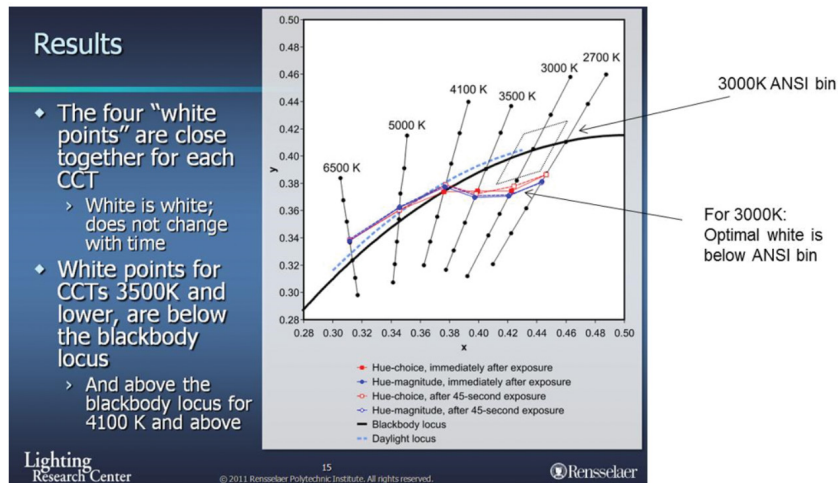


Figure 2. LRC study of 2011: persons have to judge which color point appears most white.

Spectrum of LUXEON CoB with CrispWhite Technology

Like traditional white LEDs, LUXEON CoB with CrispWhite Technology relies on blue LEDs with a typical peak wavelength of 455nm and coats them with phosphors to emit yellow-green and red wavelengths. The combination of the blue, yellow-green and red light creates the desired white light. (Traditional LEDs at 450nm are outside the FWA absorption range and do not activate FWAs.)

To excite the FWAs, LUXEON CoB with CrispWhite Technology includes some die which emits blue light with a lower peak wavelength around 415nm (patent pending). The second peak is deep blue, between 400nm and 415nm. This wavelength is short enough to stimulate the FWAs as well as far enough towards the edge of the eye's wavelength sensitivity curve that it has little effect on the perceived light with items that have not been treated with FWAs. Figure 3 shows the unique double peak of LUXEON CoB with CrispWhite Technology compared to traditional LED spectra and CDM lamp sources commonly used today in retail lighting. The typical spectra for LUXEON CoB with CrispWhite Technology and CDM sources do contain some spectral content below 420nm; the spectral content below 420nm in standard LEDs is typically negligible.

Light with wavelengths below 400nm is classified as ultraviolet and carries an increased risk of causing cataracts with extended exposure. LUXEON CoB with CrispWhite Technology uses only LEDs with dominant peak wavelengths above 400nm. Therefore, LUXEON CoB with CrispWhite Technology has less blue light hazard compared to more widely used CDM/CMH light sources.

LUXEON CoB with CrispWhite Technology has been tested for photo-biological safety. The key metric is milliwatt (mW) of UV light per kilo-lumen (klm) of total light output. LUXEON CoB with CrispWhite Technology measures half the rating of the conventional CDM lamp sources that it replaces (0.036 mW/klm for LUXEON CoB with CrispWhite Technology vs. 0.076 mW/klm for CDM). LUXEON CoB with CrispWhite Technology is rated in Risk Group 1 or “low risk.” A detailed report on photo-biological safety is available upon request from Lumileds.

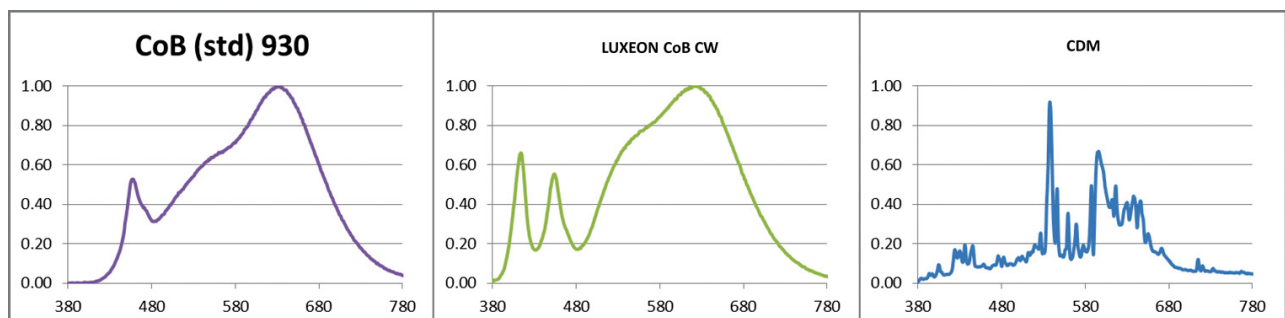


Figure 3. Compared spectra of Standard CoB, LUXEON CoB with CrispWhite Technology and Standard CDM at 3000K and 90CRI.

Color Rendering Performance

Richest Whites

Using traditional lighting in retail can sometimes lead to a yellowish hue of white merchandise. This has to do with the fact that the deep blue peak is not activated. With LUXEON CoB with CrispWhite Technology, a broad spectrum with added deep blue activates FWAs to bring out the richest whites.

Vibrant Reds

CDMs show good saturation of all colors, including reds, but even more vibrant reds can be achieved with CrispWhite Technology. Comparing the two, CDM lighting has less deep red content, making reds appear more orange. The red phosphor technology used in LUXEON CoB with CrispWhite Technology delivers a typical CRI-R9 value above 50 for vibrant red rendering, yielding the best red color for retail applications.

Colors that “Pop”

LUXEON CoB with CrispWhite Technology has a minimum CRI-Ra value over 90, ensuring all colors stand out and “pop.”

Table 1. Classification of risk groups.

CAUSES MINIMAL FADING OR DAMAGE ON MERCHANDISE	
RISK GROUP (RG)	ULTRAVIOLET HAZARD EFFICACY OF LUMINOUS RADIATION (mW/klm)
Exempt (RG0)	≤2
Low Risk (RG1)	>2 and ≤6
Moderate Risk (RG2)	>6 and ≤60
High Risk (RG3)	>60

One of the other elements discussed in retail lighting is the risk of fading. What happens to the merchandise when it is exposed to lighting? There are a couple of elements to consider:

- a. The sensitivity of the material/object being lit
- b. The power/intensity of the light source (in lumens/CBCP)
- c. The time the material/object is exposed
- d. The spectrum of the light source that is lighting the material/object

In order to assess the damage potential of different light sources, multiply the amount of power per wavelength for a light source by the Harrison damage factor for that wavelength. This value describes the relative contribution to damage for each wavelength for a specific light source. LUXEON CoB with CrispWhite Technology has been checked for damage factor and was found to be lower than the damage factor of a traditional halogen lamp and about half of the damage factor of the CDM sources it is likely to replace. In addition, the damage factor for LUXEON CoB with CrispWhite Technology is about 10 times lower than sunlight.

See below for typical Damage Factors based on the spectra of typical lighting sources including CrispWhite:



Light Source	Typ. Damage Factor
Outdoor Sunlight (downcast) 	1.5
Outdoor Sunlight 	0.8
Indoor Sunlight 	0.55
CDM lamp 4200K 	0.45
CDM lamp 3000K 	0.25
Halogen 	0.17
LUXEON CoB with CrispWhite Technology 	0.15
Incandescent Lamp 	0.08
"Normal" LED 	0.05

Figure 4. Recommended absorption correction procedure.

A Revolution in Lighting

LUXEON CoB with CrispWhite Technology revolutionizes retail lighting as we know it. By mimicking the full-body spectrum of daylight, LUXEON CoB with CrispWhite Technology brings out the richest whites, vibrant reds and colors that “pop.” The technology works by activating FWAs, allowing merchandise to appear brighter and more attractive. With a minimum CRI-Ra value above 90 and a typical CRI-R9 value over 50, LUXEON CoB with CrispWhite Technology ensures great general color perception and rich and warm colors.

About Lumileds

Lumileds is the global leader in light engine technology. The company develops, manufactures and distributes groundbreaking LEDs and automotive lighting products that shatter the status quo and help customers gain and maintain a competitive edge.

With a rich history of industry “firsts,” Lumileds is uniquely positioned to deliver lighting advancements well into the future by maintaining an unwavering focus on quality, innovation and reliability.

To learn more about our portfolio of light engines, visit lumileds.com.



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