AMBER LIGHTING

for Cleanrooms & Laboratories

SANTE - SERIES

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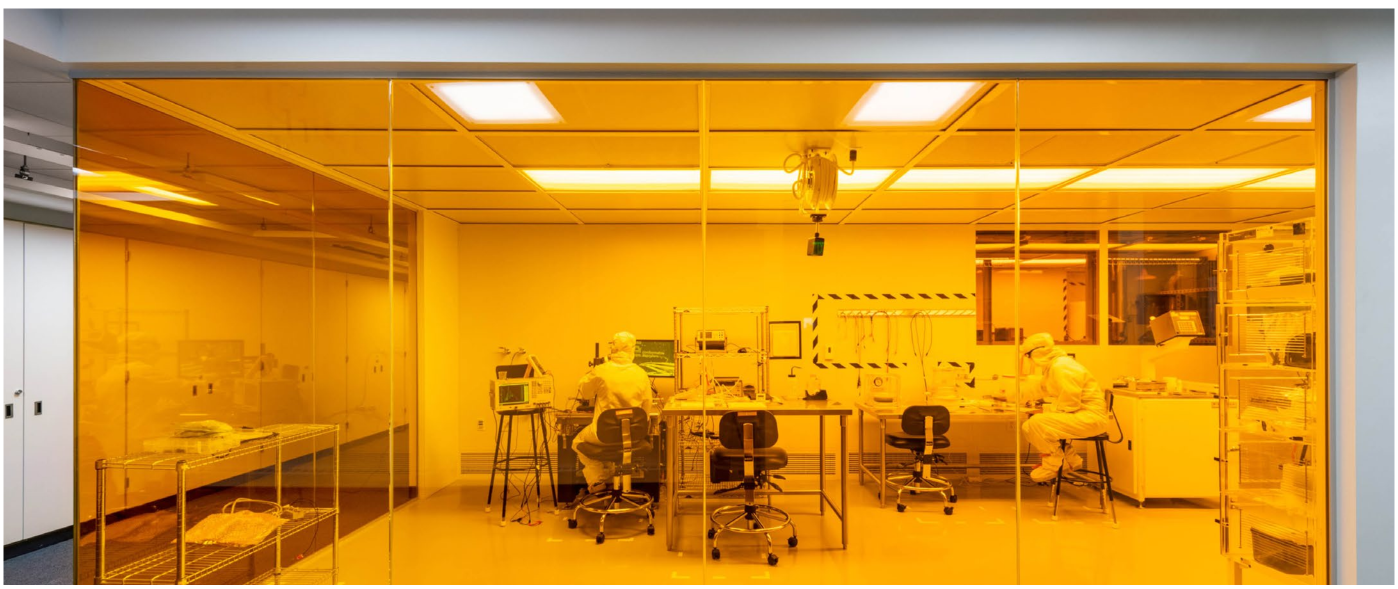
THE USE OF AMBER LIGHTING IN CLEANROOMS AND LABORATORIES TO PROTECT LIGHT-SENSITIVE MATERIALS

CLEANROOMS

Cleanrooms are where some of the world's most advanced technology—computer chips—are fabricated. The process of creating these devices is incredibly complex and often takes multiple months to create just one chip.

This is because each step of the process, from lithography to etching, must be repeated multiple times to create a finished computer chip that is ready to package and deliver to a customer. Throughout this process, materials must be protected from both particulate impurities and light, the latter of which is generally accomplished by installing yellow lighting in cleanrooms.



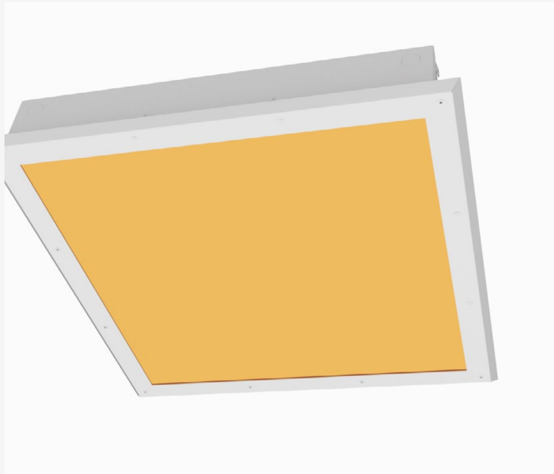
PHOTORESISTS

One of the most important steps during computer chip fabrication is lithography, which uses light-sensitive materials called photoresists that undergo reactions when exposed to UV light. The first step of this process involves dissolving a photoresist in a solvent and then spin-coating a thin film of it on top of a silicon wafer. Then, a pattern with the desired circuit design is projected onto the spin-cast resist by shining UV light through a mask. Photoresists can be either positive or negative-tone, depending on whether the photoresist becomes soluble (positive-tone) or insoluble (negative-tone) after UV exposure and/or a post-exposure bake.

LIGHT SENSITIVITY

Photoresists are susceptible to degradation due to unwanted light exposure during storage and processing—not just to UV light but also to shorter wavelengths of visible light (e.g., blue light). Fluorescent lights emit very low levels of UV light and short-wavelength visible light at 405 nm and 435 nm. Exposing photoresists to unwanted light generates a photoacid catalyst that is responsible for reactions that cause solubility changes in the photoresists, which alters their performance. Due to the catalytic nature of these reactions, even a single photoacid can catalyze up to 1,000 reactions.

[1] Therefore, exposure to even small amounts of light over a long enough period of time can irreversibly degrade the performance of a photoresist.



PRCL with Amber LEDs

METHODS TO MINIMIZE LIGHT EXPOSURE

Although photoresist formulations can be stored in light-blocking amber vials to protect against light exposure during processing, once the photoresist solution is removed from the vial (for example, to be spin-coated on top of a silicon wafer), it is no longer protected from light and is susceptible to photodegradation. Yellow/amber lighting is used in cleanrooms because its wavelength range is generally centered around 590 nm, which is much higher than the wavelengths absorbed by typical AZ®-series photoresists (generally in the range of 320–440 nm). [2] Therefore, this color of light will not induce the reactions that may degrade the performance of photoresists over time, helping ensure consistent long-term photoresist performance.

Although yellow filters can be placed over white light sources such as fluorescent bulbs, these filters will eventually degrade and require replacement—even if the bulb itself has not failed. In contrast, LEDs have a much longer lifetime, can be easily replaced, and produce a very pure light spectrum with a very narrow wavelength range.

Pa-Co Lighting's PRCL-AMBER LED series provides cleanroom-wide yellow/amber lighting that emits only a very narrow (~ 10 nm) range of light from 570nm to 580nm, ensuring a sufficiently high light intensity for performing precise cleanroom work, without affecting a photoresist's performance.

BIOLOGICAL SAMPLES AND PHARMACEUTICALS IN LABORATORIES

In addition to photoresists, biological samples and pharmaceuticals are also photosensitive and can degrade after prolonged exposure to light. This is because biological samples such as blood contain photosensitive components (bilirubin, beta-carotene, and various porphyrins) that may degrade upon exposure to light.[3] In addition, short-wavelength visible light (400–450 nm) has been shown to damage the DNA in certain cell lines.[4] Similar to blood, pharmaceuticals also undergo photodegradation because their active ingredients are organic compounds that absorb light and undergo chemical changes that alter their pharmacological properties.

Although both biological samples and pharmaceuticals can be stored in light-blocking vessels such as vials and microplates, they are not protected from light once they are removed from these containers, such as during sample transfer or analysis.

Pa-Co lighting's **PRCL-AMBER SERIES** LED products provide consistent lighting that will not degrade light-sensitive compounds, including photoresists, biological samples, or pharmaceuticals, in both cleanrooms and regular laboratories

PRCL-AMBER

NSF

MIL-STD 461G

IP66

Dimensions:

1'x 4' | 2'x 2' | 2'x 4'

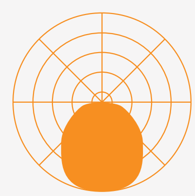
Mounting:

T-Bar / Plaster

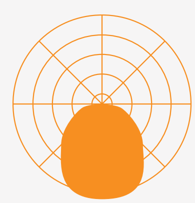
Options:

- Stainless Steel
- Rear access door
- Specialized color LED boards

Dimensions	Lumens*
1'x4'	4,000
	6,000
	8,000
2'x2'	4,000
	6,000
	8,000
2'x4'	4,000
	6,000
	10,000
	12,000



White Opal



Frosted

Spec Sheets & IES Files:

PRCL

Led Options:

2700K 3000K 3500K 4000K 5000K TW Red LED optional Amber LED optional

80 CRI | 90 CRI | COI

REFERENCES

(1) MacDonald, S. A.; McKean, D. R. PHOTOACID GENERATION IN POLYMERIC FILMS. J. Photopolym. Sci. Technol. 1990, 3 (3), 375–384. https://doi.org/10.2494/PHOTOPOLYMER.3.375.

(2) Photoresist AZ 1505 Photoresists MicroChemicals GmbH https://www.microchemicals.com/products/photoresists/az_1505.html (accessed Jul 1, 2022).

(3) Vreman, H. J.; Kourula, S.; Jašprová, J.; Ludvíková, L.; Klán, P.; Muchová, L.; Vítek, L.; Cline, B. K.; Wong, R. J.; Stevenson, D. K. The Effect of Light Wavelength on in Vitro Bilirubin Photodegradation and Photoisomer Production. Pediatr. Res. 2019 856 2019, 85 (6), 865–873. https://doi.org/10.1038/s41390-019-0310-2.

(4) Kielbassa, C.; Roza, L.; Epe, B. Wavelength Dependence of Oxidative DNA Damage Induced by UV and Visible Light. Carcinogenesis 1997, 18 (4), 811–816. https://doi.org/10.1093/CARCIN/18.4.811.

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