

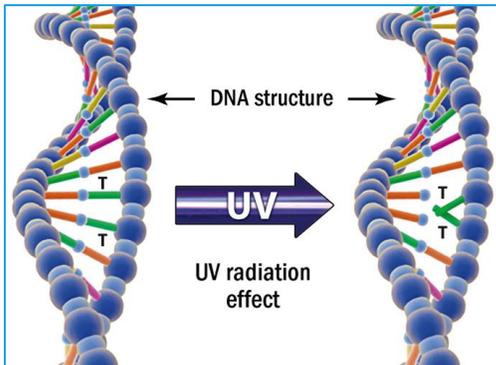
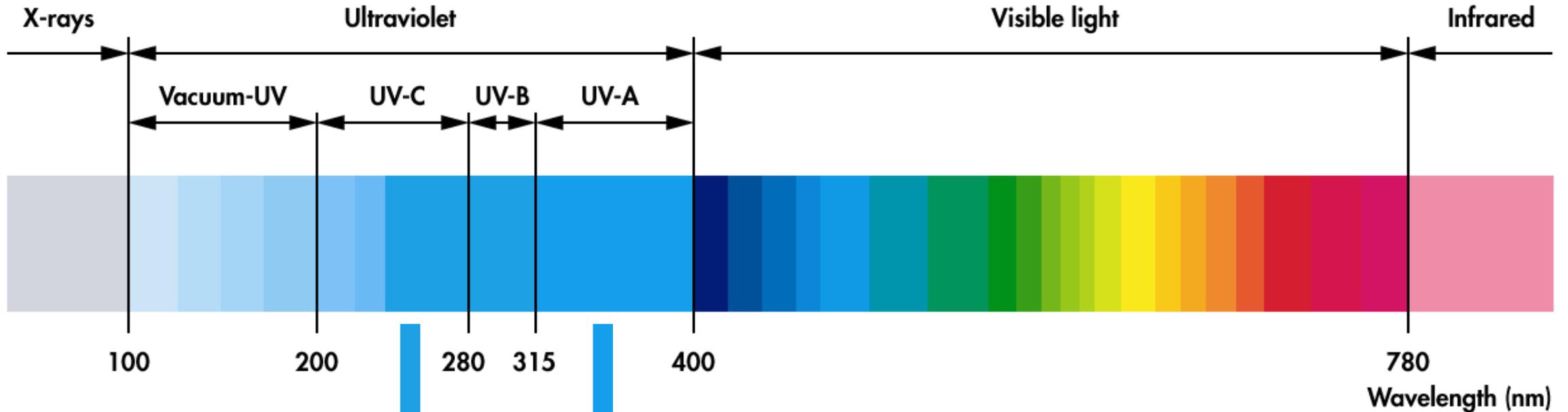


**LEDiL**®

Light that is right

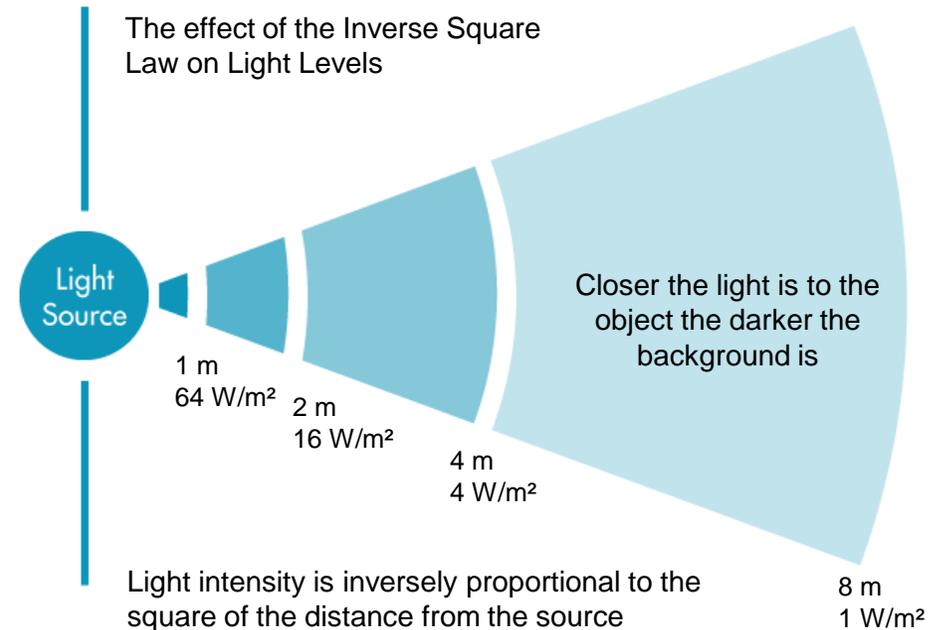
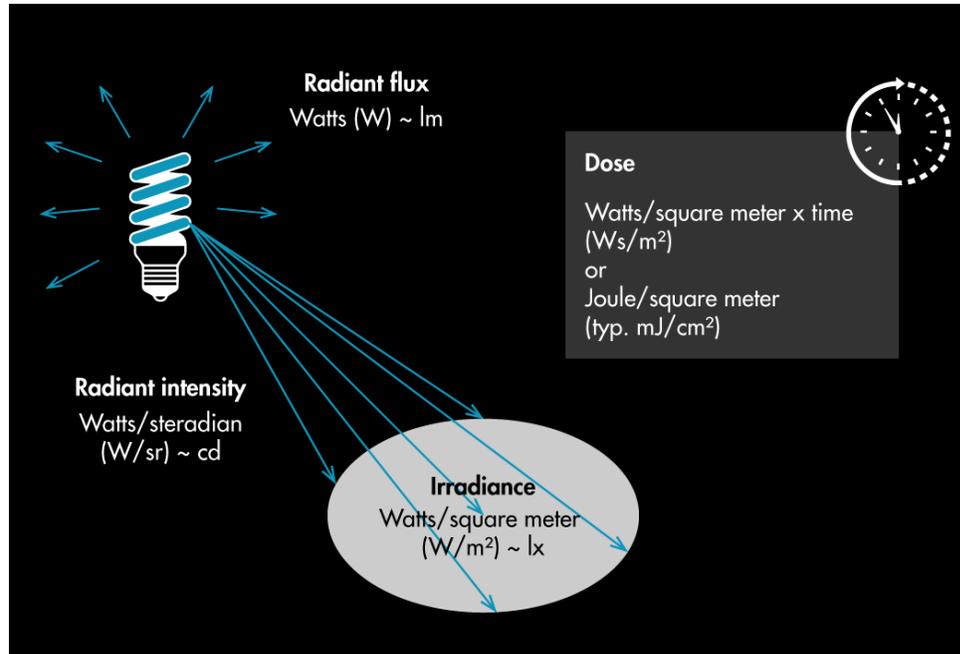
**Optics for UV applications**

# Ultraviolet light



Type of UV	Wavelength (nm)	Applications
UV-A	315–400	Printing, curing, lithography, sensing medical
UV-B	280–315	Curing, tanning and medical applications
UV-C	200–280	Used for disinfection and sensing
Vacuum-UV/ Far UV	100–200	These wavelengths propagate only in vacuum

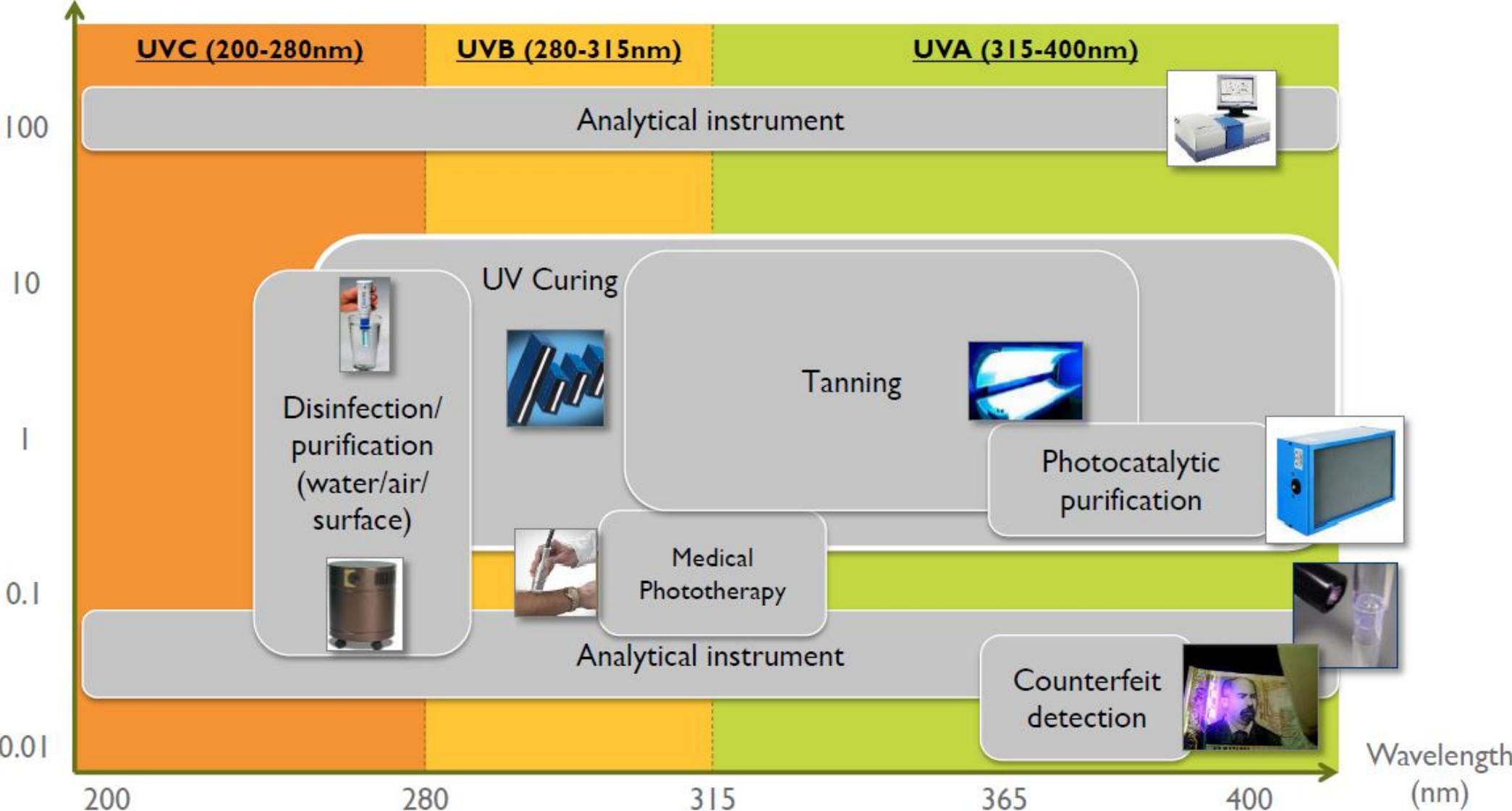
# Ultraviolet light



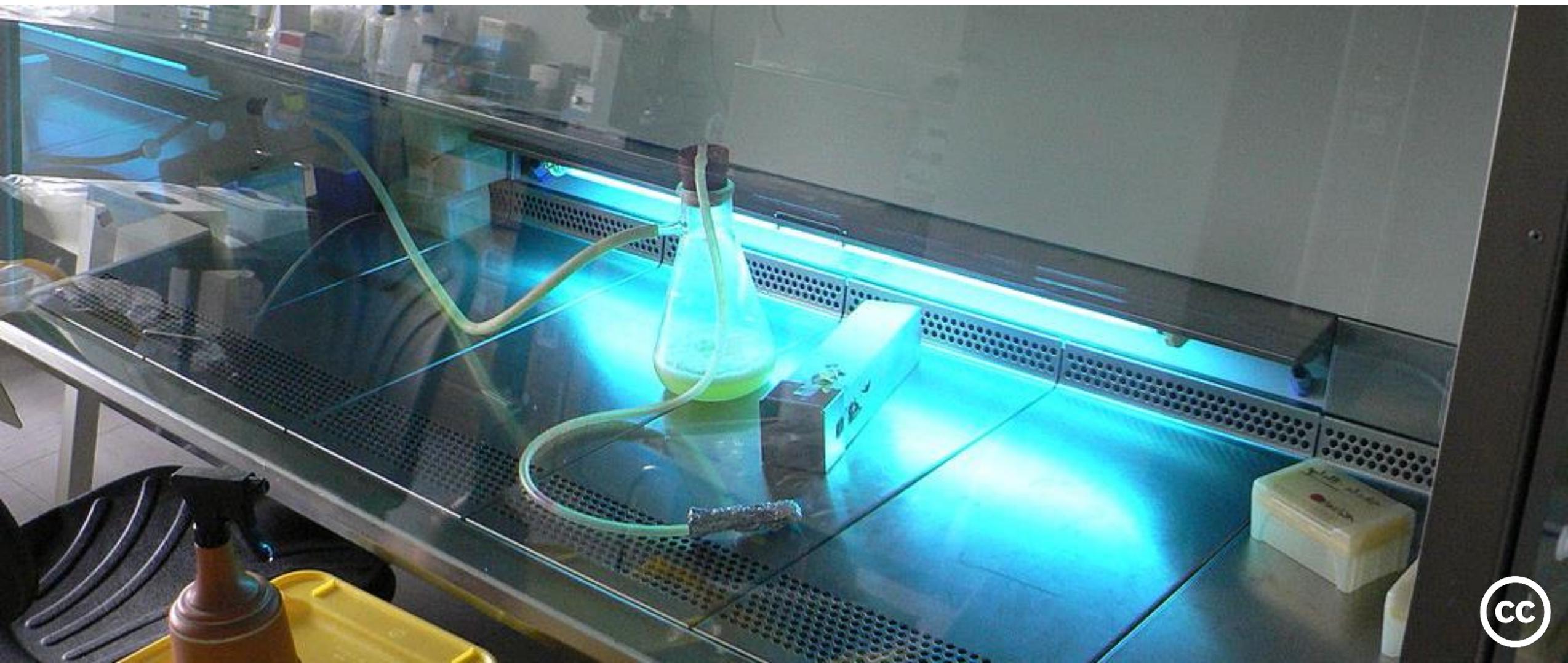
- UV-C is scattered in air which reduces its intensity
- Traditionally produced by mercury lamps with very short life, recently UV-LEDs have become commercially viable solution (longer lifetime, easier to control)
- Possible risk for humans, esp. UV-C can produce sun burns very quickly and lead to skin cancer. UV is not visible to human eye!
- Very short UV-C wavelengths produce ozone that can be a health risk

# UV applications

Required optical power output (log W/cm<sup>2</sup>)

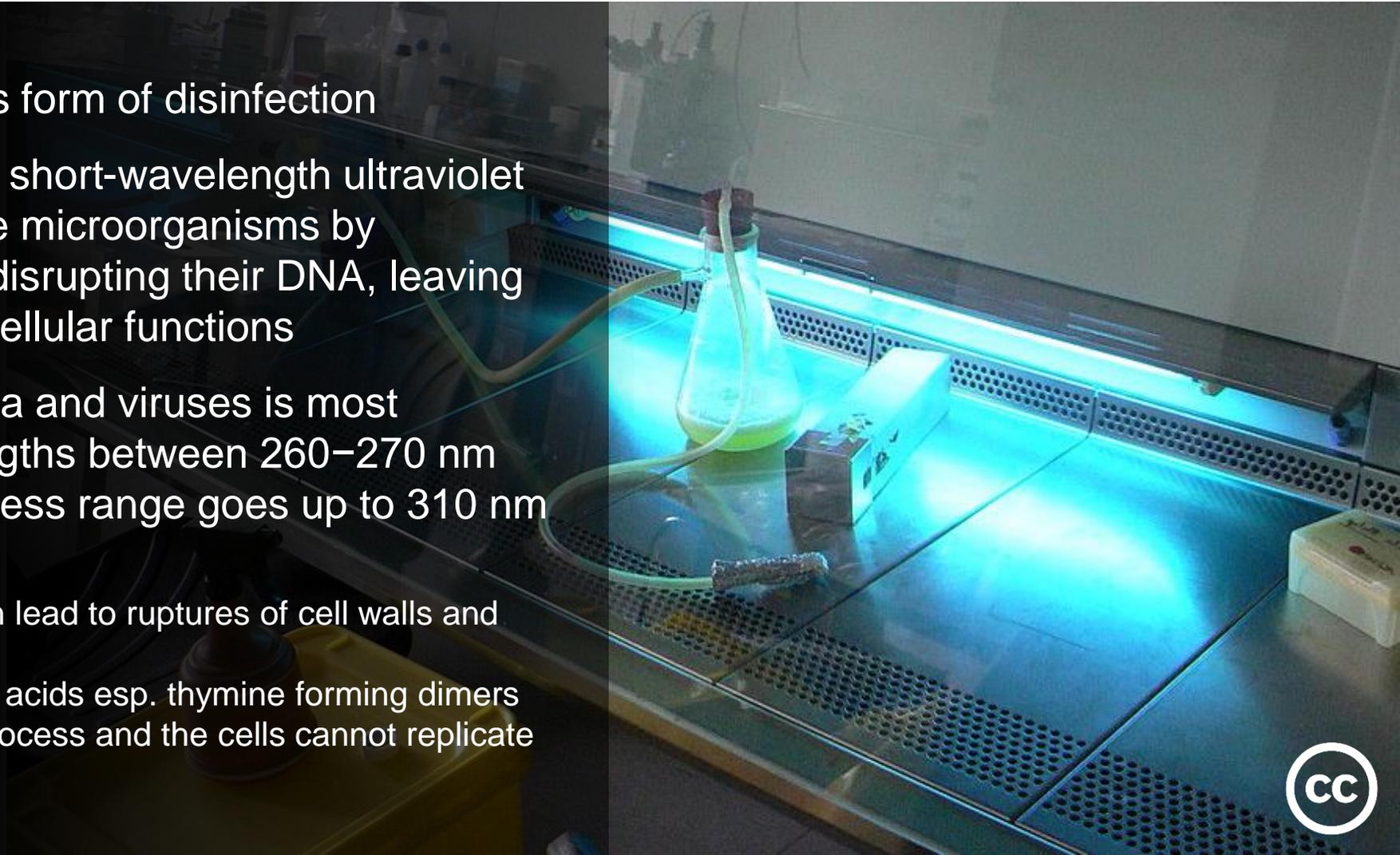


# UV-C disinfection



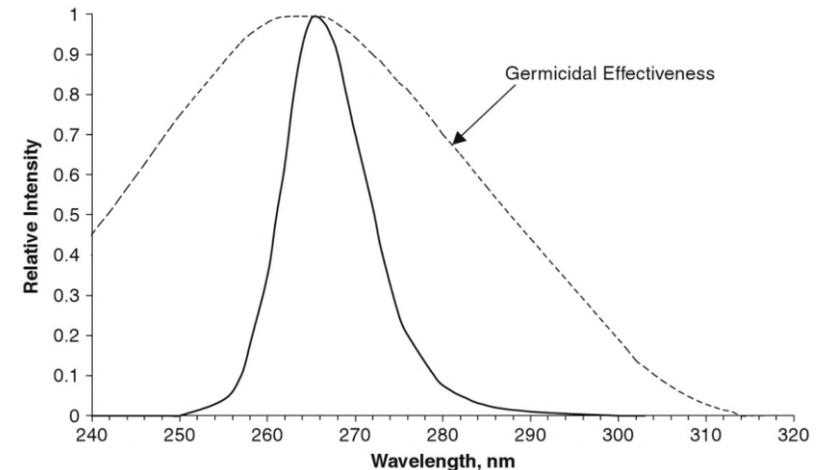
# UV-C disinfection

- Chemical free and contactless form of disinfection
- Disinfection method that uses short-wavelength ultraviolet (UV-C) light to kill or inactivate microorganisms by destroying nucleic acids and disrupting their DNA, leaving them unable to perform vital cellular functions
- DNA and RNA of most bacteria and viruses is most sensitive to radiation wavelengths between 260–270 nm however germicidal effectiveness range goes up to 310 nm wavelength
  - UV-C absorption by proteins can lead to ruptures of cell walls and death of organism
  - UV-C can break bonds in amino acids esp. thymine forming dimers which disrupt DNA replication process and the cells cannot replicate



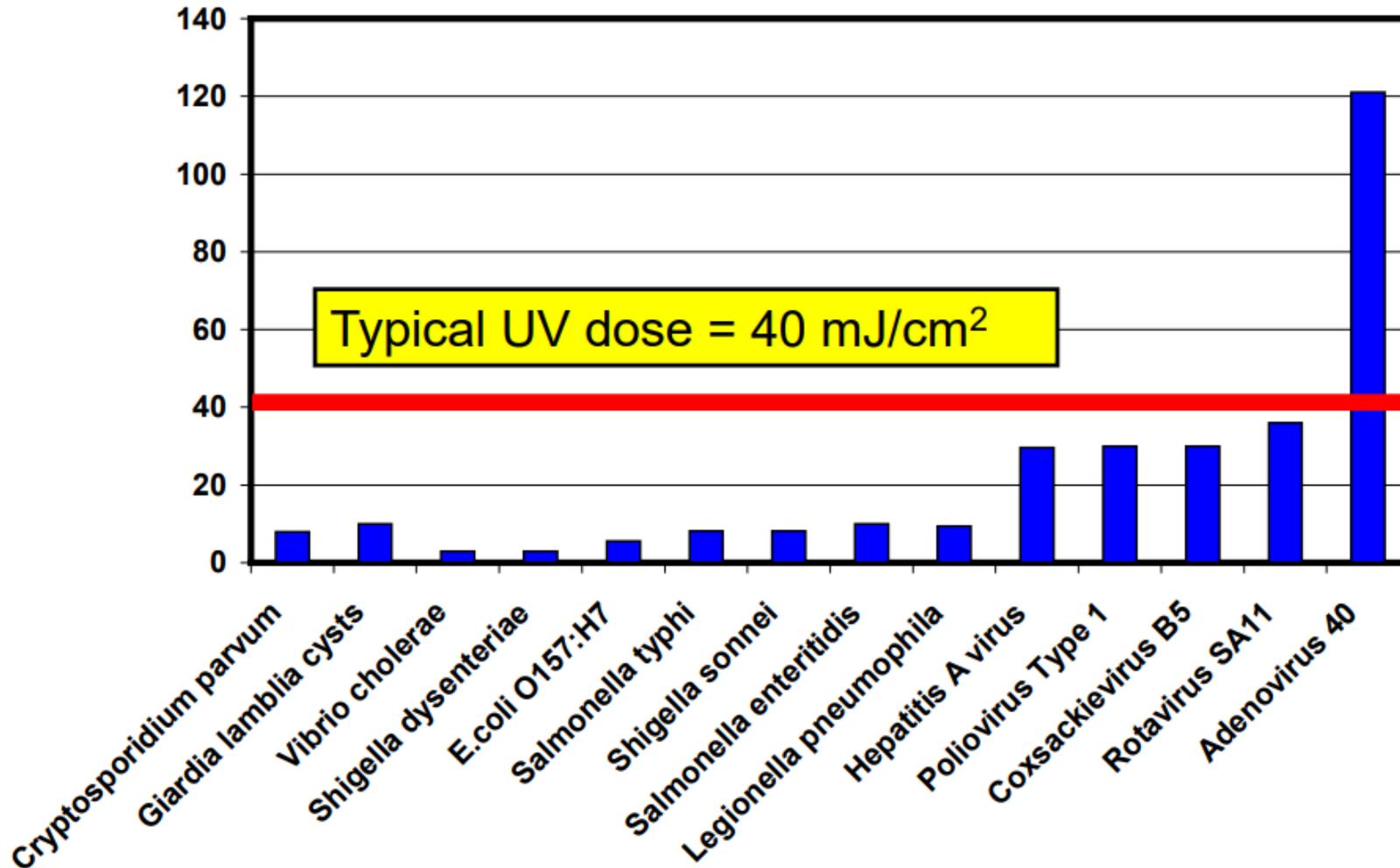
# Effectiveness of UV-C Disinfection

- Needs to be designed for lamp output at the end of lifetime
- Effectiveness depends on dosage (power x time) and wavelength, same dosage can be achieved with lower irradiance levels if the exposure time is extended
  - Effectiveness is usually measured as log reduction value i.e. logarithmic reduction of germs (1-log = 90 %, 2-log = 99 %, 3-log = 99.9 %, ...)
- Line-of sight exposure, shadowing reduces effectivity
- It is not necessary to kill pathogens with UV light, but rather apply enough UV light to prevent the organism from replicating
  - UV doses required to prevent replication are orders of magnitude lower than required to kill, making the cost of UV treatment to prevent infection commercially viable



# Dosage for disinfection

UV dose (mJ/cm<sup>2</sup>) required for 4-log inactivation



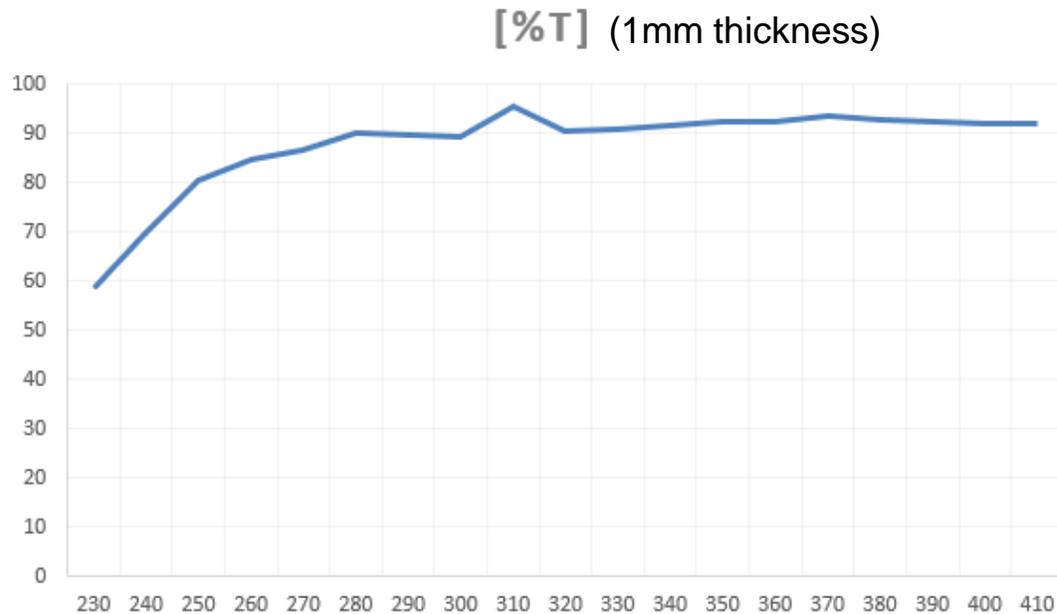
More dosages for different micro organisms:

[https://iuvanews.com/stories/pdf/archives/080104Cairns\\_Article\\_2006.pdf](https://iuvanews.com/stories/pdf/archives/080104Cairns_Article_2006.pdf)

# LEDiL materials for UV optics

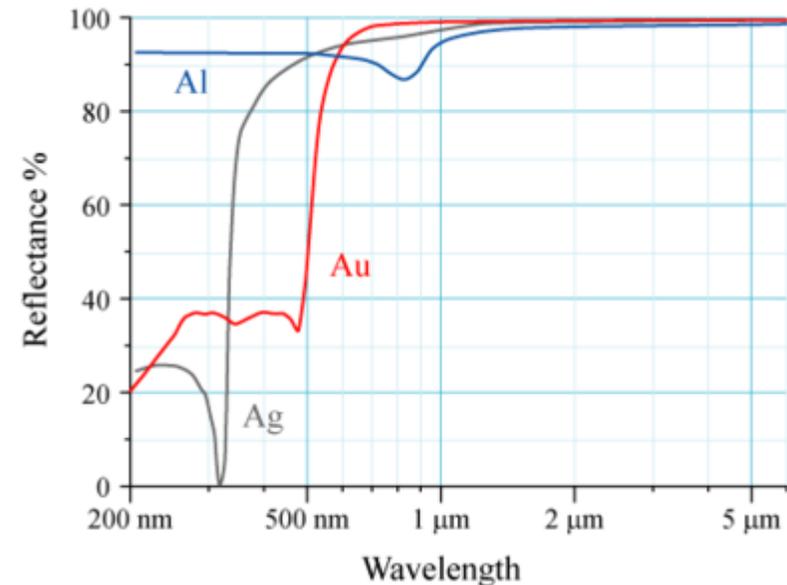
## LEDiL Silicone:

- High transmission in UV wavelengths, including UV-C
- Suitable for complex optical lens designs
- Easy to achieve ingress protection



## Aluminium:

- Cost effective option
- For UV-LED clusters
- Highly reflective in all UV wavelengths



# LEDiL UV optics

UV-A

UV-B

UV-C



## VIOLET

- 12-up lens
- Clusters or single LEDs 3535, 6868, CSP

UV-A

UV-B

UV-C



## STELLA (WWW, Fresnel)

- Clusters up to 30 mm
- 3535, 6868 packages, CSP

UV-A

UV-B

UV-C



## ZORYA

- Big clusters
- Clusters 3535, 6868, CSP

UV-A

UV-B

UV-C



## ALISE

- Clusters up to 22 mm
- 3535, 6868, CSP

UV-A

UV-B



## JENNY (CY)

- Clusters up to 11 mm
- 3535, CSP

UV-A

UV-B



## SAGA

- Clusters up to 14 mm
- 3535, 6868, CSP

UV-A

UV-B



## G2-ROSE-UV / G2-NIS033U

- Single LEDs 3535/6868

UV-A



## SAKURA

- Clusters up to 25 mm
- 3535, 6868, CSP

**ROSE-UV**

# G2-ROSE-UV / G2-NIS033U

## *Performance and durability*

- A full set of lenses for both flat packaged and domed UV-LEDs
- Made of optical grade silicone with very good UV-withstanding
- Substantially improved performance and durability

### Features

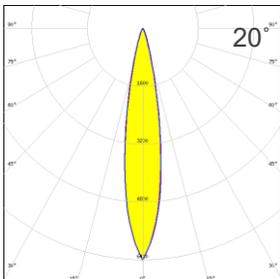
- 21.6 x 21.6 mm, H 12.9 mm
- For UV-A and UV-B applications

### Typical Applications

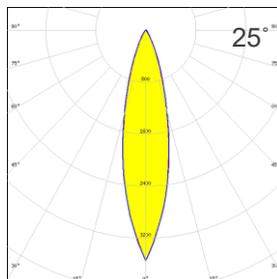
- Non-destructive testing
- Curing applications
- Anti-bacterial lighting

### Compatibility

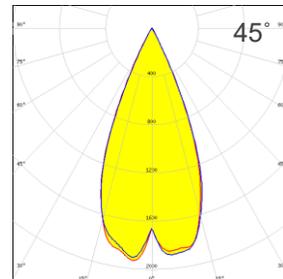
- Rose UV: UV optics for 3535 sized dome LEDs
- G2-NIS033U: UV optics for ceramic flat packages up to 7575 size



FA14011\_G2-NIS033U-S  
FCA15007\_G2-ROSE-UV-SS



FCA14405\_G2-NIS033U-M  
F14686\_G2-ROSE-UV-M

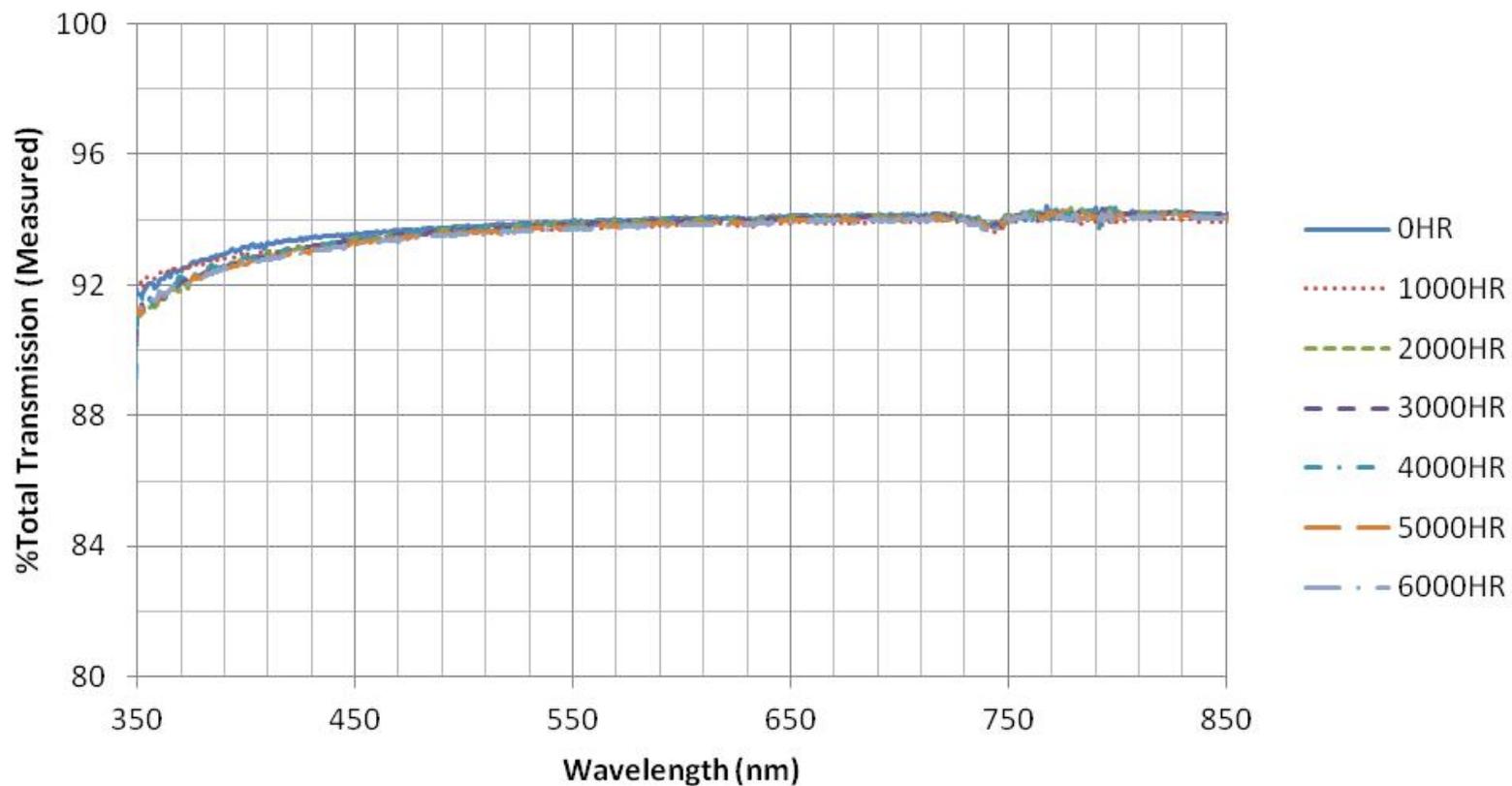


FCA14464\_G2-NIS033U-W  
FCA15009\_G2-ROSE-UV-W

# UV-TESTING RESULTS

*ROSE-UV family*

## UV Aged Transmission at 1W/m<sup>2</sup>



ROSE-UV lenses exposure for heavy UV-radiation over 6000 hours without noticeable change in the transmission.

**ZORYA for UV**

# ZORYA

*~340° omnidirectional lens*

- Omnidirectional light distribution suitable for confined spaces
- Thin lens doesn't reduce intensity
- Easy ingress protection due to silicone technology

## Features

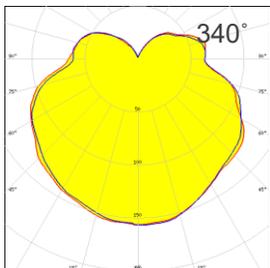
- Ø56 mm, H 29.48 mm
- High efficiency with excellent UV, heat and impact resistance
- Can be used as it is, or with external protective cover
- Can achieve IP-ratings
- Typical amount of uplight 30-40 %

## Typical Applications

- Disinfection cabinets
- Applications where distance from lens to application is limited

## Compatibility

- Cluster of UV-LEDs up to 30 mm size
- Bender+Wirth mica-connectors



F15074\_ZORYA-SC

**STELLA for UV**

# STELLA-HB-WWW

*”Cost optimized” large UV cluster solution*

- Low profile wide lens for large clusters
- ~90° beam for very wide high bay lighting applications
- Low profile design with a large space reserved for connectors

## Features

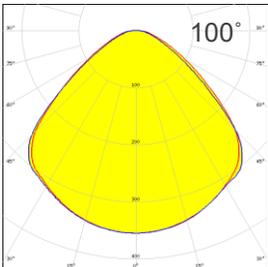
- Ø90 mm, H 11.3 mm
- Maximum connector size: diameter 52 mm, height 6 mm
- Good uniformity

## Typical Application

- Room disinfection
- Area disinfection

## Compatibility

- Compatible with UV-LED clusters up to 32 mm in diameter
- The best performance can be achieved with 18 mm cluster size



FN15264\_STELLA-HB-WWW



# STELLA-FRESNEL

## *Narrow beam for UV-C*

- The same footprint as the other members of STELLA family
- Narrow Fresnel-lens beam suitable for clusters of UV-C LEDs

### Features

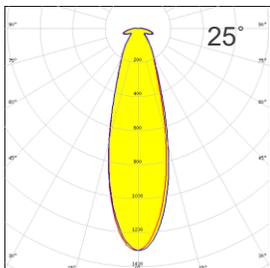
- Ø90 mm, H 23 mm
- Typical FWHM 20-35° subject to LES size
- High efficiency with excellent uniformity
- Narrow beam helps to achieve higher intensity radiation

### Typical Applications

- Room disinfection esp. in higher rooms

### Compatibility

- Compatible with UV-LED clusters up to 30 mm diameter
- Can be used also with Zhaga type solderless connectors from a range of manufacturers



FN14720\_STELLA-FRESNEL



**ALISE**

# ALISE

*Cost efficient and versatile reflector system for UV*

- Thermally capable solution
- Suitable for cluster light engines
- Highly reflective aluminium suitable for UV-C

## Features

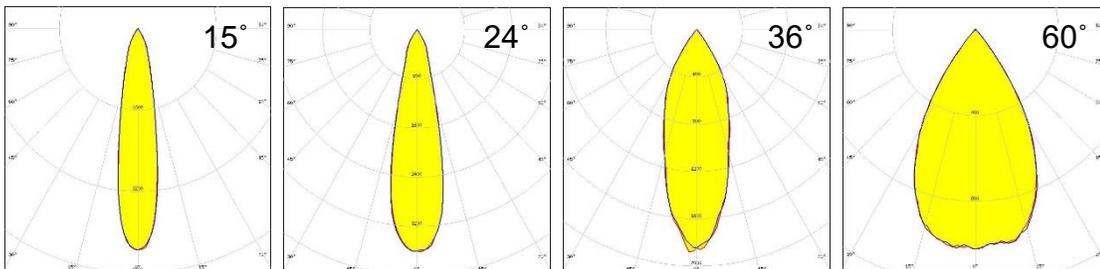
- Ø50 mm, Ø70 mm, Ø110 mm
- Made of aluminium (for good heat resistance)
- Attachment to small upper flange
- Efficiency ~90 %

## Typical Applications

- UV-C disinfection
- Room disinfection

## Compatibility

- Optimized:
  - Ø50 mm: LES 10 mm
  - Ø70 mm: LES 14.5 mm
  - Ø110 mm: LES 22 mm
- Optimized for Zhaga connectors  
e.g. Lumawise LED holders Z35, Z45, Z50



C16907\_ALISE-50-S  
C16903\_ALISE-70-S  
C16899\_ALISE-110-S

C16908\_ALISE-50-M  
C16904\_ALISE-70-M  
C16900\_ALISE-110-M

C16909\_ALISE-50-W  
C16905\_ALISE-70-W  
C16901\_ALISE-110-W

C16910\_ALISE-50-WW  
C16906\_ALISE-70-WW  
C16902\_ALISE-110-WW



**VIOLET**

# VIOLET

## *Silicone optic for UV-C applications*

- Lens and metal frame made from highly resistant UV materials
- Special silicone grade for high UV transmittance
- Can be used with up to 4 LED clusters\* for maximum efficiency and output
- Enables creation of more cost-efficient solutions than with quartz glass

\*Depends on LED

### Features

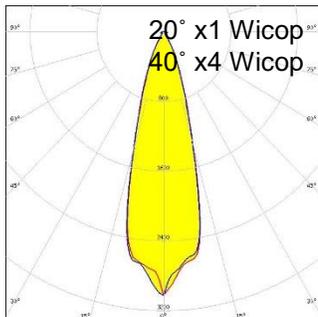
- 293.3 x 41.6 mm
- 12 lenses
- Metal frame
- Up to IP67

### Typical Applications

- Disinfection (surface, air, water)
- Horticultural lighting (prevention of plant diseases etc)

### Compatibility

- UV LEDs from Seoul Viosys, Nichia

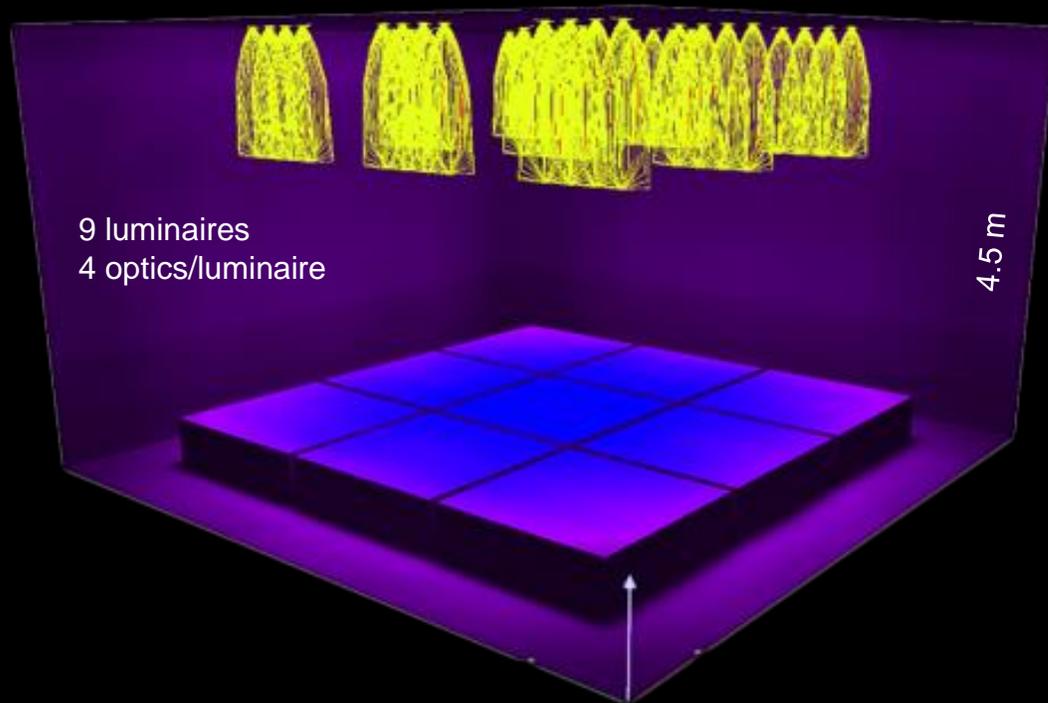


FN17294\_VIOLET-12X1-S

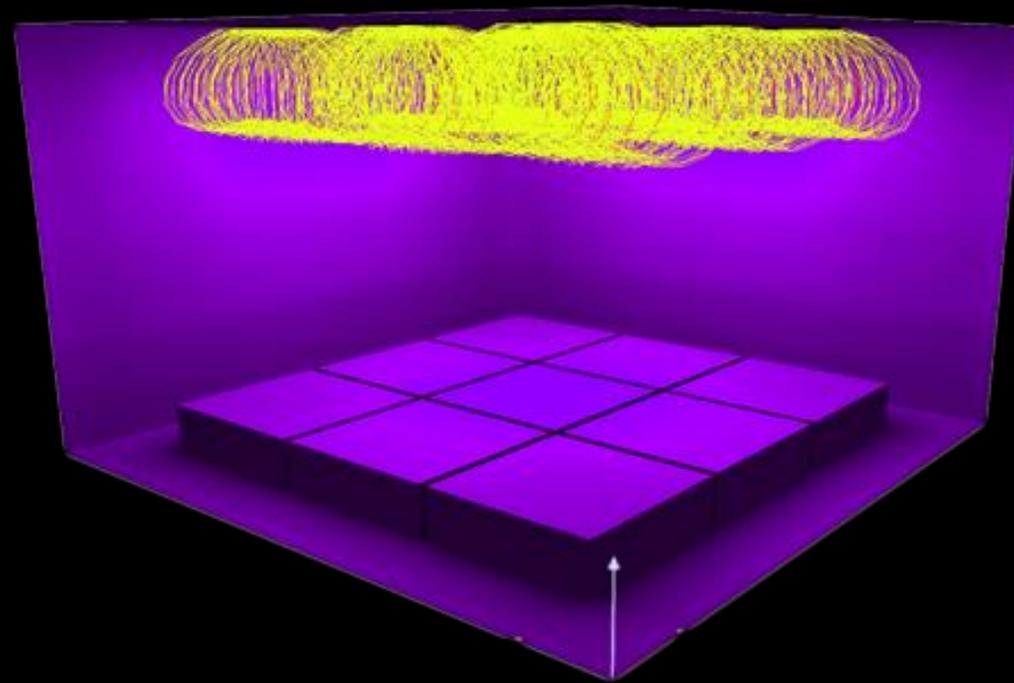


# EXAMPLE 1/2

## Disinfection with VIOLET vs quartz glass



VIOLET with Wicop LED



Wicop LED only

### RESULTS

On workplane at 0.6 m

Average:	5.0 W/m <sup>2</sup>
Min:	4.8 W/m <sup>2</sup>
Max:	5.1 W/m <sup>2</sup>
u0:	0.971

### RESULTS

On workplane at 0.6 m

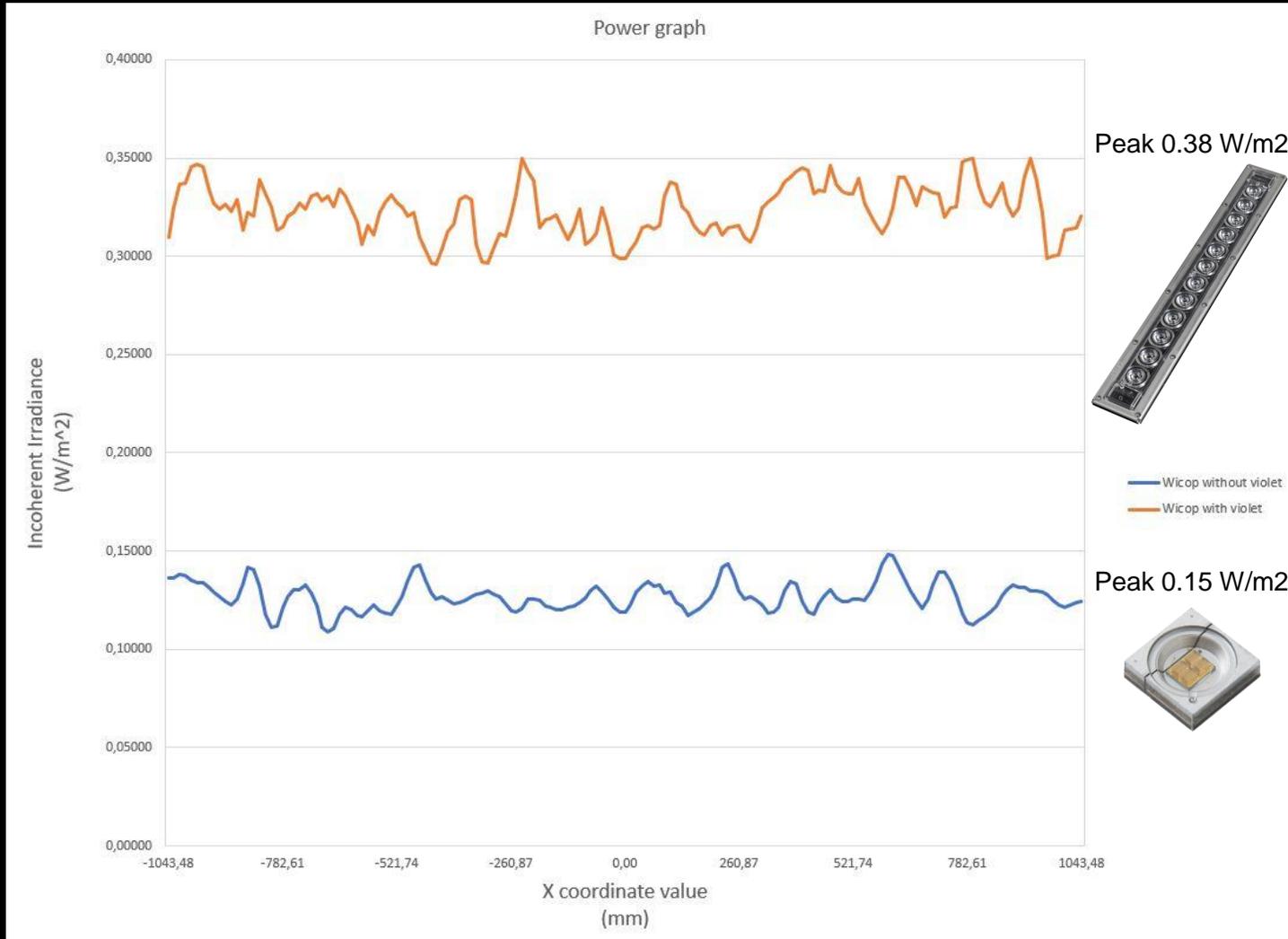
Average:	2.8 W/m <sup>2</sup>
Min:	2.7 W/m <sup>2</sup>
Max:	2.8 W/m <sup>2</sup>
u0:	0.979

Irradiance



# EXAMPLE 2/2

*Irradiance: VIOLET with Wicop LED vs Wicop LED only*



A nighttime photograph of a cityscape featuring a large body of water in the foreground, a modern stadium with a glass facade in the middle ground, and several high-rise apartment buildings in the background. The scene is illuminated by streetlights and building lights, creating a warm, yellowish glow. The text 'LEDiL' is overlaid in a large, bold, yellow font, with a registered trademark symbol (®) to the upper right of the 'L'. Below it, the slogan 'Light that is right' is written in a white, sans-serif font. At the bottom center, the website address 'www.ledil.com' is displayed in a yellow, sans-serif font.

**LEDiL**®

Light that is right

[www.ledil.com](http://www.ledil.com)