Crystal IS™
High Performance UVC LEDs

UVC LEDs for
Environmental Monitoring

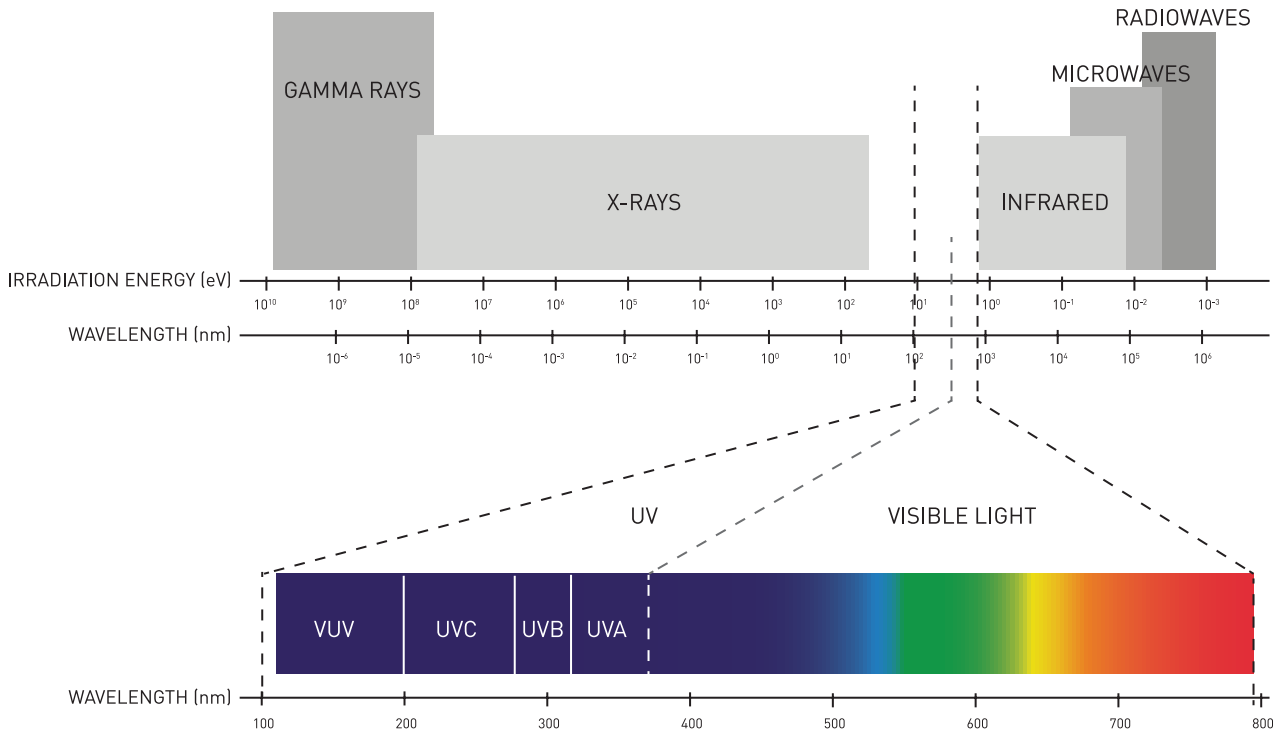
Environmental monitoring relies extensively on molecular spectroscopy for tracking air quality, water and wastewater quality, and detecting hazardous substances.

Advances in instrumentation for environmental monitoring give rise to the following emerging needs:

- **Real-time monitoring which enables quick response**
- **Instruments with less maintenance and calibration requirements for remote operation**
- **Miniaturized sensors with low power requirements for easy installation and onsite monitoring**

Traditionally, absorption and fluorescence spectroscopy instruments have utilized broad spectrum lamps such as xenon, mercury or deuterium, as these generate ample light across multiple wavelengths.

However, in order to develop instruments that meet evolving needs across industries, adoption of alternative light sources, such as LEDs, is essential. Crystal IS UVC LEDs have several attributes that make them the undisputed choice.



High Performance UVC LEDs for Environmental Monitoring

Crystal IS manufactures high performance UVC LEDs in the 250–280 nm wavelengths using proprietary aluminum nitride (AlN) substrates and cutting-edge LED fabrication technology. Our LEDs offer higher light outputs and longer lifetimes than other UVC LEDs, making them ideal for emerging spectroscopic applications in environmental monitoring.

- **Industry leading light output**
- **Superior light output maintenance over time**
- **Excellent spectral quality**
- **Tolerates highest drive currents**

COMPARISON OF LEDs WITH TRADITIONAL LAMPS FOR SPECTROSCOPY				
	LED	**Deuterium Lamp**	**Xenon Flash Lamp**	**Mercury Lamp**
Spectrum	Single Peak	Broad Spectrum	Broad Spectrum	Broad Spectrum
Stability of Light Output	Excellent temporal and spatial stability	Good	Relatively Poor	Relatively Poor
Warm Up Time	Instantaneous	20–30 Minutes	Instantaneous	1–15 Minutes
Thermal Effect on Samples	None*	Heat-sensitive samples can be affected	None	Heat-sensitive samples can be affected
Cost of Ownership	Low**	High	High	Low
Drive Electronics	Simple	Complex	Complex	Complex
Safety	Low voltage and cold light source	Hot bulb surface; High voltage power supply	High voltage supply; Ignition and sparking risk	High voltage supply and contains mercury in fragile quartz envelope

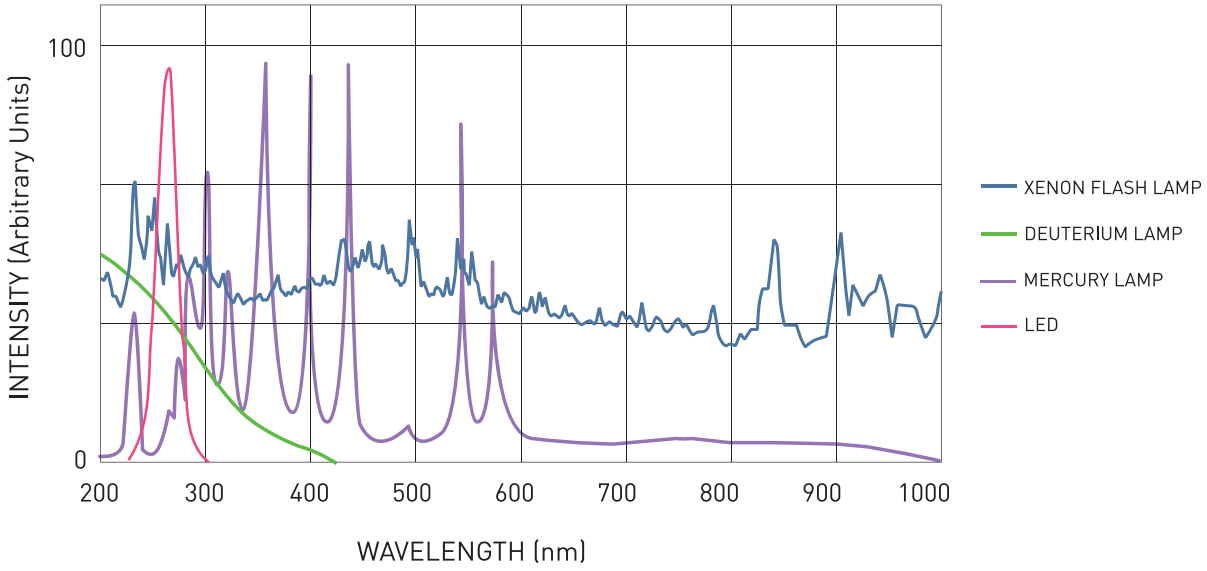
***** **LEDs do not emit forward heat**
****** **Lowered cost of ownership due to cost savings on power supply and housing, and lack of filters required**

Table 1. LEDs Compared with Traditional Light Sources

Single Peak Benefits for Spectroscopy

In any single spectroscopic application, light at a discrete wavelength is useful for the measurement, and filters are typically used to suppress any undesired wavelengths from a broad spectrum UV lamp. This approach can diminish the intensity at all wavelengths, including the desired wavelength. Moreover, adding filters to the optical path adds to the cost of the design.

Unlike the broad, complex spectra of UV lamps, deep UV (UVC) LEDs have simple spectra—a single peak with narrow spectral bandwidth. Monochromaticity of LED light sources avoids loss of light through filtering. Crystal IS LEDs allow users to select wavelengths that match the specific absorption peaks of target molecules or the specific excitation wavelength of fluorophores in their spectroscopy applications.

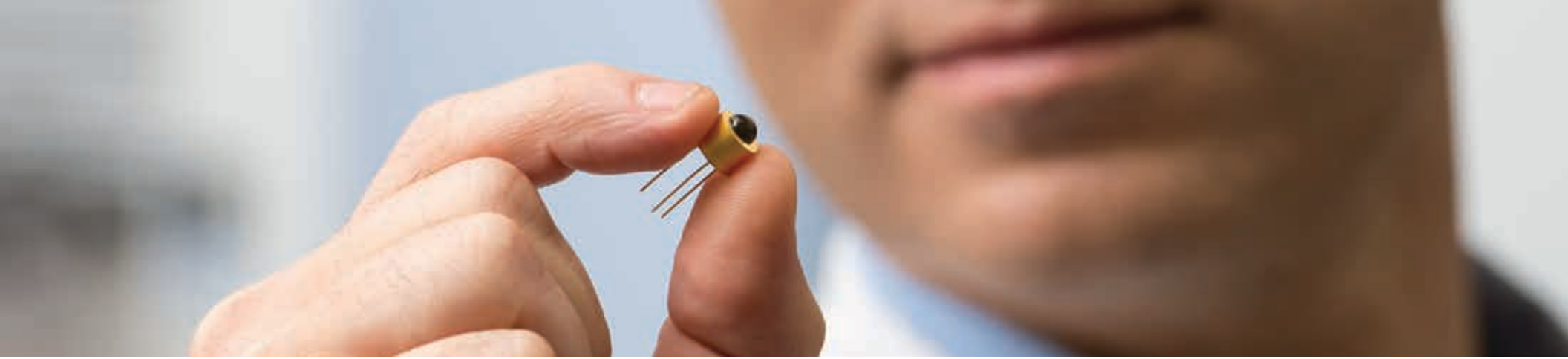


Simplicity of LED Drive Electronics Enables Ease of Operation

LEDs provide a low voltage, low direct current option to traditional UV light sources. LEDs have relatively inexpensive drivers whose lifetimes exceed hundreds of thousands of hours, and are capable of providing the required current input to LEDs over their entire lifetime.

In contrast, traditional UV light sources require higher voltages to increase light output and have more complex requirements for power supplies and ancillary electronics. This has implications for safety, cost, thermal management and ease of operation.

This simplicity of electronics for LEDs enables more compact product designs and packages and opens options for product evolution or tailoring for specific applications.



Stability of Light Output for Measurement Accuracy and Reliability

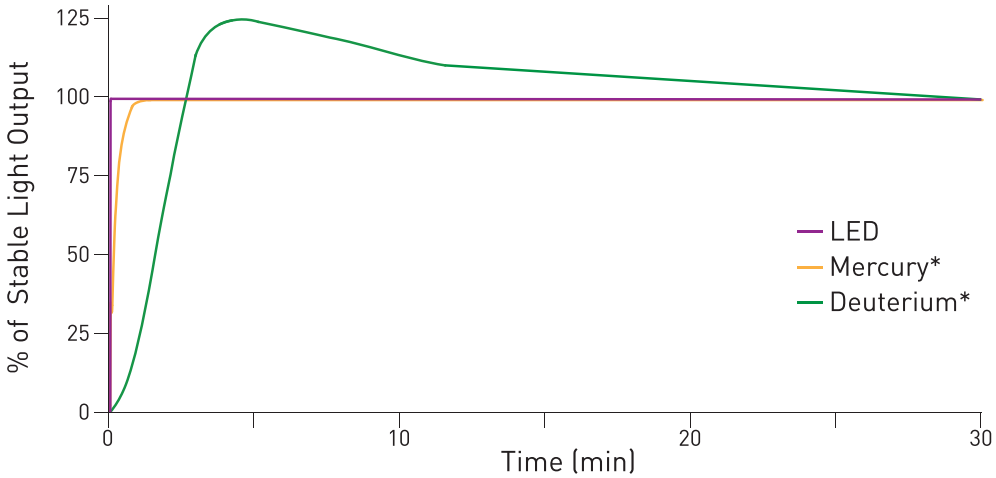
Stability of light output is critical to ensuring low baseline noise and increased detection limits in absorbance measurements. LEDs are notably stable light sources, unencumbered by the mechanisms, which lead to fluctuations in other traditional UVC light sources. Stability of light output in LEDs is impacted primarily by junction temperature, which can be maintained with a host of simple thermal management techniques.

Instant On/Off Capabilities Enhance and Enable Applications

Unlike filament-based or arc-based UV lamps, LEDs reach their full brightness in under a microsecond once turned on and do not have a prolonged glow when turned off. This instant on/off results in conservation of energy during operation and longer replacement cycles for LED light sources.

Optan™

- Peak wavelengths from 250 nm to 280 nm
- Light output bins from 0.5-4+ mW
- Ball lens with viewing angle of 15°
- Drive currents up to 100 mA
- Hermetically sealed
- RoHS-compliant
- TO-39 package



*** UV light source warm up time data as pulled from typical product literature**

Ozone Monitoring

Ground-level ozone is one of the most commonly found air pollutants created by chemical reactions between oxides of nitrogen and volatile organic compounds in the presence of sunlight. Considering the extensive range of health hazards it imposes, the current EPA ozone standard is set at 75 parts-per-billion (ppb) underscoring the critical need to monitor ground level ozone in the parts-per-billion level.

Absorption of UV light at 255 and 280 nm can be used to quantify the amount of ozone in the air.

Crystal IS UVC LEDs offer several advantages for ozone monitoring applications.

- **Stability of light output allows for more accurate results**
- **High light output enables shorter optical path length than traditional UV lamps, providing quick measurements**
- **Long lifetime, low operating voltage and small form factor enable use in mobile and handheld devices**

Oil-in-Water Monitoring

Industrial facilities rely on quick and reliable monitoring of oil and other hydrocarbons in water and wastewater for leak detection, pollution prevention and environmental discharge compliance. Detection of petroleum hydrocarbons in water can identify heat exchanger failures. Rapid leak detection using spectroscopic measurements saves thousands of dollars in operational and maintenance costs.

UV fluorometry is used to monitor oil and hydrocarbons because the aromatic component in these substances fluoresce under UV light.

Crystal IS UVC LEDs offer many advantages in UV fluorometry.

- **Narrow wavelengths for selective, targeted measurements**
- **Small footprint for easy inline monitoring of water quality**
- **High light output for trace detection in the parts-per-billion levels**

Colored Dissolved Organic Matter (CDOM) Monitoring

CDOM is a subset of dissolved organic material in the ocean (and lakes, streams, etc.) that is optically active. High concentrations of CDOM affect aquatic vegetation, coral reefs, and biological activity in aquatic systems. UV fluorometry at 250 and 280 nm monitors CDOM in marine and freshwater systems to preserve these sensitive, and often remote, ecosystems.

Crystal IS UVC LEDs have many benefits for your CDOM monitoring needs.

- **Real-time monitoring enables timely detection and appropriate response to save costs and preserve the environment**
- **Long lifetime and simple electronics of LEDs enable maintenance-free, continuous, remote operation**

Bioaerosol Detection

Bioaerosols that contain harmful bacteria or bacterial spores (e.g. bacillus anthracis, clostridium botulinum) can be extremely toxic to health. Amino acids in these bacteria cause them to fluoresce under UVC wavelengths, making UVC fluorescence spectroscopy useful for bio-agent detection and warning systems.

Crystal IS UVC LEDs enable better, more effective bioaerosol detection systems.

- **Reduced size, weight and power consumption enables handheld devices**
- **Instant on/off provides quick measurements**
- **Low cost of ownership reduces system cost**

Water and Wastewater Monitoring

Rapid detection of changes in water quality is critical in water delivery systems to ensure environmental preservation and consumer health. Wastewater treatment plants monitor water quality in the effluent to assess effectiveness of treatment processes and compliance with regulatory requirements for the discharge of treated water.

Water treatment plants monitor organic matter, as excessive accumulation can cause microbial growth and affect water quality. UV photometry provides quantitative analysis of the organic content in water. By using continuous spectroscopic measurements, instead of intermittent chemical testing with grab samples, end-users can gather process information, detect issues in water quality and make the necessary process changes in real time.

Parameters used to measure water typically include UV absorbance (UV254), total organic carbon (TOC), biological oxygen demand (BOD) and chemical oxygen demand (COD). Local, state and federal regulations often require monitoring of one or more parameters for environmental, health or safety reasons.

Crystal IS UVC LEDs offer several advantages for water monitoring applications.

- **High spectral quality of our LEDs provides measurement linearity over a wide range**
- **Mercury-free construction and increased energy efficiency for sound environmental design**
- **Long life, low maintenance UV source for improved cost of ownership**

Crystal IS UVC LEDs

Our UVC LEDs offer higher light outputs and longer lifetimes than other UVC LEDs, making them ideal for emerging spectroscopic applications in environmental monitoring. Compared to traditional UV sources, LEDs are monochromatic, more compact, environmentally friendly and provide lower cost of ownership.

We invite you to discover the power of Crystal IS UVC LEDs.

Crystal IS™
High Performance UVC LEDs

70 Cohoes Avenue
Green Island, NY 12183
U.S.A.

www.cisuvc.com
518.271.7375
sales@cisuvc.com

1010-1312