Crystal IS™
High Performance UVC LEDs

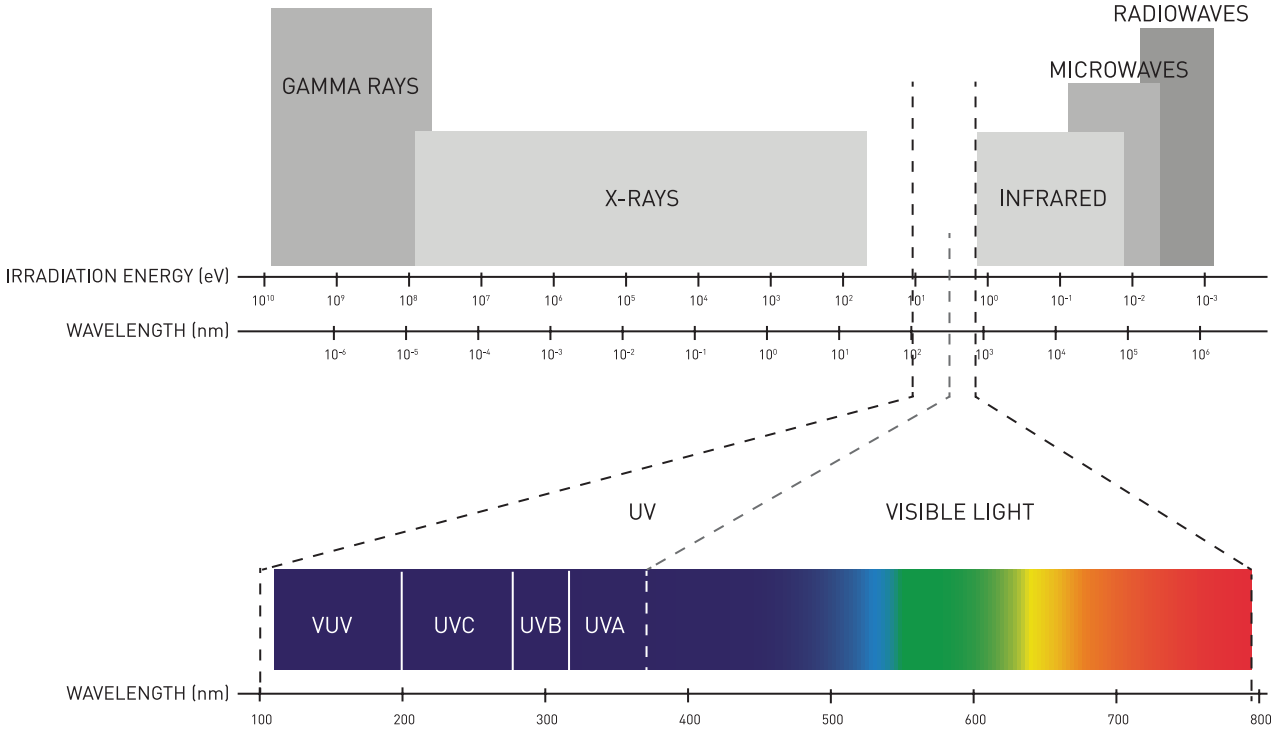
UVC LEDs for
Life Sciences

Life science instrumentation relies extensively on molecular spectroscopy for several analyses that are essential for drug manufacturing, nucleic acid and protein measurements as well as for observing events in living cells in real-time.

Advances in the bio-instrumentation sector give rise to the following emerging needs in instrument design:

- **Compact instruments which minimize lab footprint**
- **Measurement of heat sensitive samples**
- **Quicker measurements which increase productivity**
- **Single parameter instruments which are cheaper**

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 scientific instruments that meet evolving needs in the industry, 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 Life Science Instrumentation

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 the life sciences.

- **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

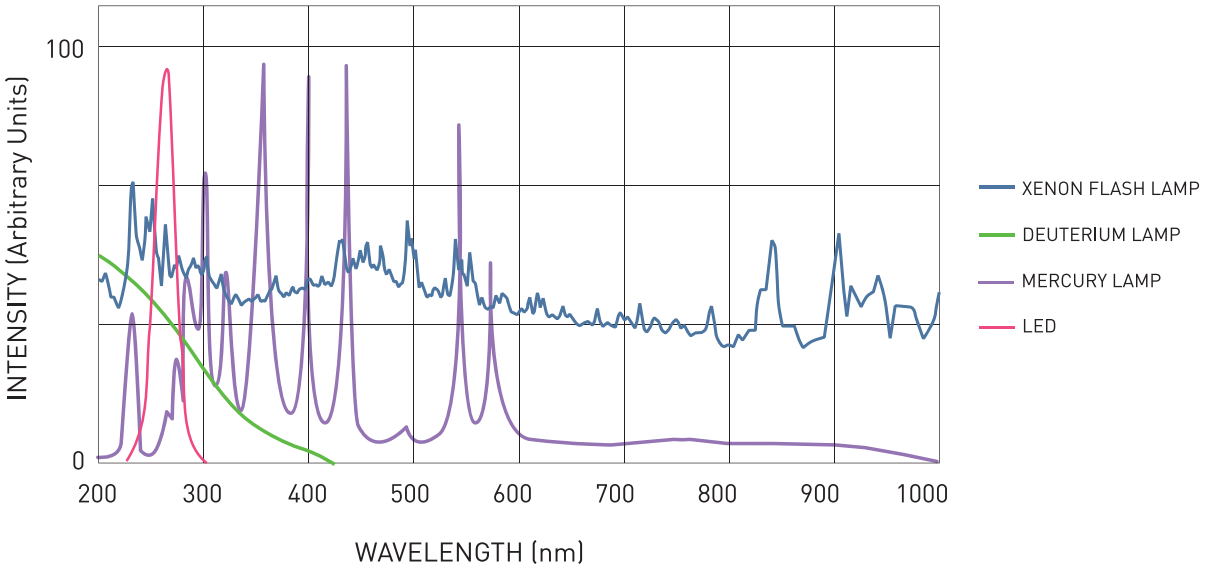
* LEDs do not emit forward heat
** Lowered cost of ownership due to cost savings on power supply and housing, and lack of filters required

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.

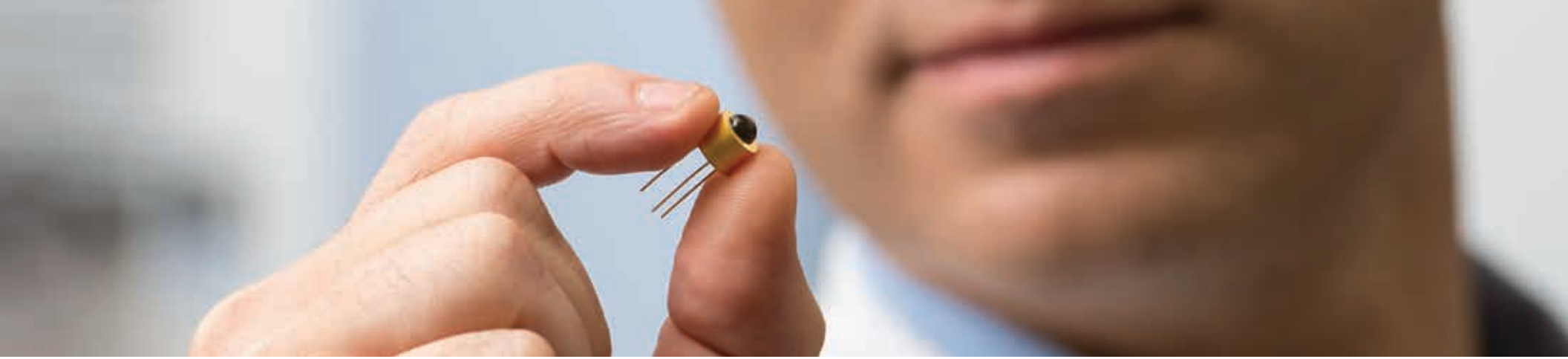


Simplicity of LED Drive Electronics Enables Ease of Operation

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

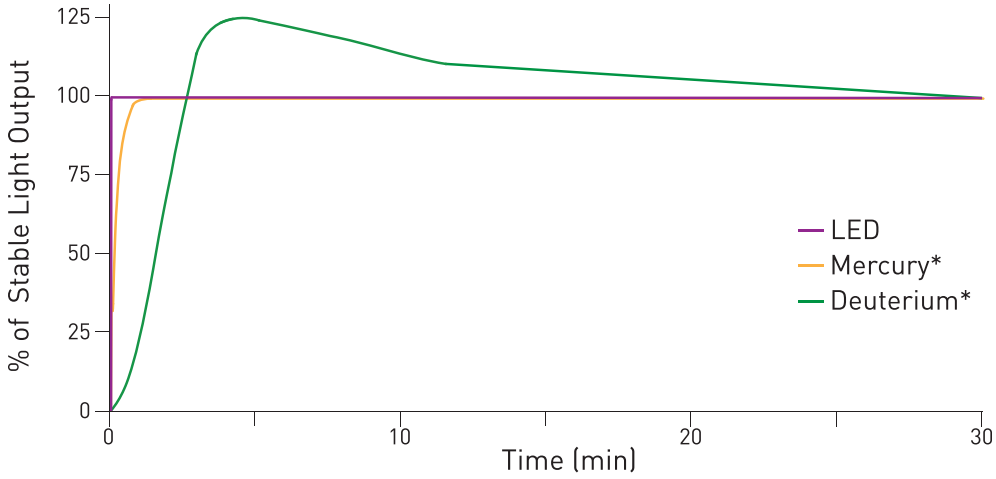
Stability of light output is critical to ensuring low baseline noise and increased detection limits in absorbance measurements. LEDs are notably stable light sources, unencumbered by the mechanisms, which lead to fluctuations in other traditional UVC light sources. Stability of light output in LEDs is 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**

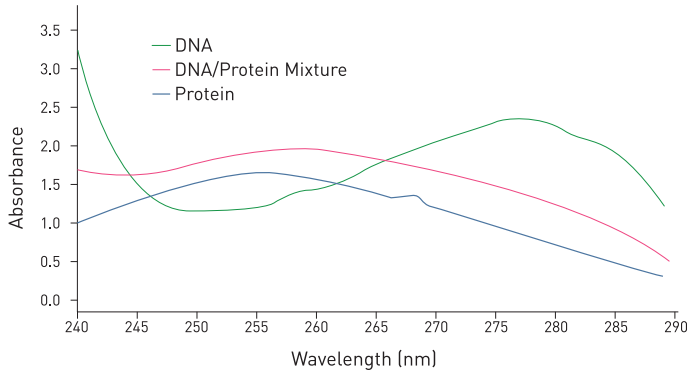
DNA Purity Measurement

Biological techniques such as polymerase chain reaction (PCR) and DNA sequencing have specific target or window of nucleic acid concentration for optimum performance, necessitating reliable measurements of the concentration and purity of proteins and nucleic acids.

Quantitative analysis is based on the Beer-Lambert's law—the relationship between degree of absorption and the concentration of the absorbing material. Both protein and DNA absorb UV light, but they have different absorbance curves. UV spectroscopy saves time in optimizing the reaction and reduces use of costly reagents by measuring the ratio of absorbance at 260 nm (pure DNA/RNA) and 280 nm (protein contaminants) to determine the purity of the sample.

Crystal IS UVC LEDs used in these instruments increases efficiency, decreases costs and improves the quality of measurements.

- **High spectral quality of Crystal IS LEDs provides measurement linearity over a wide concentration range**
- **Small footprint enables compact product design to maximize lab real estate**
- **Instant on/off leads to greater number of sample measurements to increase productivity**
- **Single peak and simple drive electronics allow for less costly, application-specific instruments**



High Performance Liquid Chromatography (HPLC)

HPLC has several applications in the pharmaceutical industry from drug discovery through development and manufacturing. It is used for analyzing complex mixtures, purifying chemical compounds, developing processes for synthesizing chemical compounds and in raw material quality control.

UV absorption spectroscopy is the most popular detection technology in HPLC since many analytes absorb in the UV spectrum while solvents remain transparent at these wavelengths. Nearly 80 percent of all known chemicals and materials can be identified with HPLC including aromatic carboxylic acids (255 nm), water soluble vitamins, analgesics (280 nm) and proteins (280 nm).

Crystal IS LEDs provide several benefits in HPLC:

- **Little or no forward heat protects thermally sensitive samples**
- **Instant on/off increases lab bench productivity**
- **Emission pattern allows for easy alignment**
- **Light source and the associated electronics can be isolated from the flow cell for explosion proof applications**

Fluorescence Imaging

Fluorescence microscopy with UV light is used for live cell imaging to understand protein interactions and offers insights not possible using fixed cell techniques. High-throughput imaging of protein crystallization experiments with UV light helps crystallographers accurately differentiate between crystals of protein and those of salt, and eliminates errors associated with human inspection.

Crystal IS LEDs provide several benefits in fluorescence imaging:

- **Modulation capability of LEDs eliminates high-speed mechanical shutters for vibration-free experiments**
- **Stability of light output and precise intensity control make it possible for images to be taken under identical excitation conditions for long term experiments**
- **Lack of forward heat eliminates thermal effect on samples and increases cell viability**
- **Uniform illumination across the field of view for data accuracy in quantitative imaging**

Protein Research

Protein research is integral to targeted drug development as well as disease diagnosis. Aromatic amino acids in proteins such as tryptophan (Trp), tyrosine (Tyr) and phenylalanine (Phe) fluoresce when excited with UVC light. The shape and magnitude of the intrinsic fluorescence spectrum is used to identify local environment of amino acids, determine proximity relationships and measure events in living cells in real-time.

Time-resolved fluorescence provides more information about the molecular environment of the fluorophore than steady-state fluorescence measurements. Many macromolecular events occur on the same time scale as fluorescence decay. Thus, time-resolved fluorescence spectroscopy can be used to investigate these processes and gain insight into chemical surroundings of the fluorophore.

Benefits of Crystal IS LEDs for core protein research:

- **Narrow spectrum for selective excitation of different amino acids**
- **Lack of forward heat and use of remote light sources eliminates thermal effects on samples**
- **Instant on/off facilitates instantaneous modulation for time resolved measurements**

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 life sciences. 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.

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High Performance UVC LEDs

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