# UV LED curing technology

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discusses some of the important key features of UV LED curing technology

Ultraviolet curing technology is utilised for drying coatings and other UV-sensitive materials through polymerisation. UV light-emitting diode improves on that existing process by enabling thinner, heat-sensitive substrates, while reducing harmful byproducts such as ozone and improving workplace safety. Additionally, UV LEDs can be turned on and off instantly, utilising input power efficiently to enable lower operation costs over the application lifetime.

## TECHNOLOGY

As UV LED curing technology continues to gain worldwide adoption, it is important to keep in mind some of the important key features that build a robust product optimised for high performance and long lifetime. There are many product options on the market for UV LED but not all of them are built to support rugged and industrial environments.

Reliability is very important for UV curing so make sure to find a supplier that does highly accelerated life testing (HALT) to confirm the products are proven to be reliable. In addition, product engineering is also an important key feature when selecting a UV LED supplier.

### Light emitting diodes

Not all LEDs are built the same nor do they exhibit the same characteristics. UV LED lamp suppliers have critical choices to make as to the quality, type, material and shape of LED for their systems. Key LED characteristics considered by each UV LED lamp supplier include wavelength and UV output.

Some LED manufacturers only sell their LEDs pre-packaged into arrays or assemblies that they feel maximise the UV output. UV LED lamp system suppliers that purchase pre-packaged arrays have typically made a tradeoff between faster time-to-market and less differentiated lamps versus a slightly longer time-to-market and maximising UV power. This is an area where UV LED lamp suppliers can differentiate themselves based on the suppliers' architecture and engineering capability where two suppliers can take the same batch of LEDs and achieve very different performance in the end product.

### Optics

UV LED optics are one of the most important differentiators in UV light sources. The science of optically improving the LEDs to maximise their UV output is key to the lamp's final capability. Based on the end application, the optical engineer has to decide what shape, form and material best utilises the LED's unique characteristics. Next they have to balance the fact the LEDs are a 'flood' type of light, unlike a focused mercury lamp where the light is captured by a reflector and directed to a specific point, focal length.

The optical engineer is challenged to use methods to ensure the maximum amount of light 'escapes' at the desired irradiance through the window/glass towards the material. LED Lamp suppliers have used various, confidential methods to maximise the UV LED light.

While an end-user or OEM should not necessarily be concerned with how the optics are provided in the UV LED lamp, they should understand if the supplier has the ability to improve their design for their specific application needs.

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| Increased Productivity | Improved yields<br>Higher Speeds<br>Tighter process control<br>Physical plant control |
| Operating Economics | Up to 90% energy savings<br>Utilize less expensive raw inputs<br>Low heat on substrates<br>Longer lifetime |
| Sustainability | No ozone<br>No mercury disposal<br>Safer workplace<br>Government subsidies |

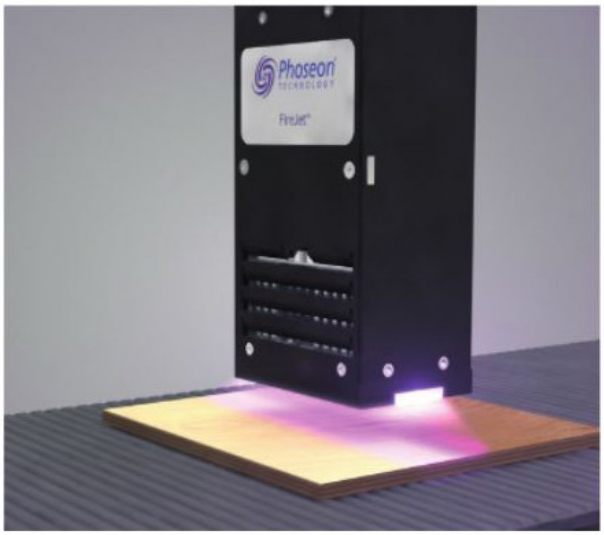
## UV IRRADIANCE

UV output continues to improve every year, opening the door to new high-performance applications. Water-cooled UV LED curing products are now available on the market with 12W/cm$^2$ peak irradiance at 365nm wavelength. Scalable air-cooled products are available at 8W/cm$^2$ peak irradiance at 365nm wavelength. These high-performance products are ideally suited for curing adhesives and coatings where 365nm is the specified wavelength. The high peak intensity increases application performance and throughput to levels that were not previously possible.

### Wood coatings

Due to recent advances in high-powered air-cooled products, UV LED curing technology can now be used in the wood coatings industry for applications, such as edge coating, roller coating and digital


**Phoseon Firejet FJ200 Light Source (8W/cm$^2$ at 365nm)**




printing. UV LED technology drastically reduces energy consumption and significantly reduces workpiece surface temperature. Edge coating manufacturing lines utilise UV LED to ensure consistent, high-quality results. Machines can be made more compact due to small form factor; speed can be increased due to consistent UV output; and the diffuse nature of UV LED light can be used to more effectively cure shaped surfaces, which previously required multiple lamps at various angles.

UV LED is a perfect match for roller coating lines both for controlled gelling and full-cure stations. The benefits include better factory floor utilisation due to shorter, more efficient lines; increased uptime with no degradation in UV output, lower-cost input stock due to lack of infrared heat; and reduced operating costs by more efficient electricity use and no need for costly air ducting systems.

While technically not a wood application, creating a natural wood-grain look on diverse materials is made possible with UV LED cured ink-jet printing. By using a combination of pinning and full-cure lamps, realistic 'look' and more importantly 'feel' is enabled by creating texture to mimic the grains of natural wood. This is especially valuable in decorative and accent applications.

### Industrial

Countless manufacturing processes make use of the benefits of UV LED curing. Applications range from manual curing of the adhesives used during sub-component assembly, to high-speed curing of coatings and colourings of the finished products. Many electronic product manufacturers are already reaping the benefits of using UV LED curing to improve their manufacturing processes. Touch screens, mobile phones, micro speakers and hard disk drives provide just a few examples of commercial applications.

### Automotive

UV LED curing solutions are being utilised by the automotive industry for paint and coating touch-ups, window and sunroof seals, plus a wide variety of other applications.

### Advanced display technology

Another emerging application is display manufacturing for cell phones, OLED TVs and touch screens. UV LED technology is a great fit, and offers more consistency with less heat transmitted to the panel. By eliminating heat damage of electronic components, LED technology can be used on more materials offering improved manufacturing yields.

### Decoration

Decorative printing processes allow for ultra-high gloss, matte and holographic effects. 'Cast and Cure' is a fast growing technology that creates a holographic style decorative finish on a variety of substrates for sheet-fed and web applications. 'Cold Foil' is the application of metallic foil, in line, at press speed in an infinite spectrum of colours. These effects can be created with UV LED technology in a wide variety of environments.

### 3D textured printing

Due to the low heat generation, UV LED allows for curing on surfaces such as wood, metals, ceramic tiles, plastics, glass and plastic for 3D textured printing. Pinning of successive layers allows textures that provide for depth and realism. Additionally, curing of adhesive or coating in successive layers provide for better adhesion and flow control.

### Direct bottle printing

UV LED curing technology is utilised for decorative bottle printing for glass containers for spirits, health and beauty, wine, cider, beer, bottled water, soft drinks, food and the promotional glassware industry. This decorating process utilises UV LED light sources for curing inks on glass containers to improve the quality of print.

## CONCLUSION

UV LED curing is now an accepted user-friendly tool in adhesive, coating and printing markets. These industries continue to challenge and drive the formulation/chemical material suppliers with UV LED wavelength optimised materials.

End users are increasingly asking equipment manufacturers for LED options and the market-leading vendors are responding. Confronted with such exciting and rapidly evolving technology, system builders and end users are closely monitoring the ever-changing UV LED curing landscape.

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