PROCESSING TECHNOLOGY

Four reasons to use LED lighting in your facility

By Tatiana Koutchma on 8/18/2014

Light-emitting diodes (LEDs) are semiconductor devices that emit light of a single wavelength. Visible (blue, green and white) and infrared LEDs became commonplace in many electronics and lighting applications. The reason for this shift in the visible region is an extremely high efficiency (up to 80%) and long lifetime (around 100,000 hours) achieved in just the past couple decades.

LEDs also can be designed to produce ultraviolet (UV) light at the optimal germicidal wavelength. UV LEDs are the next wave in the LED revolution that brings the advantages of LEDs to the UVA, UVB and UVC regions of the spectrum. Most people are familiar with UVB and UVA from sunlight as causing suntan and sunburn.

UV light in the germicidal wavelength range or UVC from 200 to 400 nm, has the power to inactivate bacteria, viruses, cysts and mold from air, water and surfaces easily, safely and effectively. UVC disinfection is a validated technique for producing potable water without the use of chemicals and has been approved by the US Department of Health and the Environmental Protection Agency (EPA). The FDA approved UVC light for water applications in the food industry as well as for surface disinfection.

Epi-layers

Traditionally, UVC light is generated with high voltage arc-discharge mercury or amalgam lamps. These lamps are effective in disinfection but are not environmentally-friendly, and they require significant setup and maintenance.

LEDs typically are fabricated by depositing very thin, highly crystalline layers of various compositions on a crystalline wafer substrate; these layers are referred to as epi-layers. The wavelength emitted by an LED is defined by the material properties of the epi-layers. Aluminum nitride (AlN) and gallium nitride (GaN) alloys typically are used to fabricate UV LEDs emitting light with wavelength in the germicidal range.

1. Operating advantages

Miniature, robust, and operating with a low electrical power, UV LEDs can be manufactured with a highly stable output, operating at the optimum wavelength for the application.

Other advantages such as no warm up time, mercury free and potential long lifetime can make them ideal for compact and portable processing solutions.

2. Flexibility for a variety of processing and sanitizing solutions

The list of UV LED applications will certainly grow. For example, UV LEDs can easily be incorporated into simple water filters providing a highly effective solution for potable water needs that is easy to install and use with minimal supervision, maintenance and space.

Another unique feature of LEDs is to run effectively in a cold room environment. It was explored by USDA scientists who tested LEDs in the range of 285-305 nm to extend shelf-life of fresh fruits and vegetables in domestic refrigerators. Shelf-life doubled using 20mW/m2 of UV LEDs power. The emission wavelength of LEDs can be tuned by design to match the most effective wavelength for disinfection in a given environment.

3. Shelf-life extension and energy savings

Perhaps the most widespread application for UV LEDs is general lighting. According to research from Kansas State University a switch to LED lights in in refrigeration units can save retail meat industry million of dollars. Using LEDs allows save energy and extend the color shelf-life of some beef products. Five meat products displayed under LEDs lighting had colder internal product temperature compared with fluorescent light that helped to extend their shelf-life. Better wavelength match can results in higher system efficiency and thus, additional energy savings.

4. Potential high efficiency

To displace the incumbent mercury-based technology, UV LEDs require further development to improve device efficiency and lifetime. For LEDs emitting in the UVC range shorter that 360 nm, the highest efficiency so far has been in the range of a few percent. As device efficiency improves, LEDs will begin to replace the existing UV light source market as a cost-effective, environmentally friendly alternative to save energy, improve safety and shelf-life.