WRITING SAMPLE

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Solid-State Engineering:

An overview of LED technology, solid-state engineering and its implications for commercial horticulture environments

By Gretchen Heber

Controlled environment agriculture is undergoing a revolution, powered by light emitting diodes (LEDs). As Earth's resources — including arable land and water — dwindle, forward-thinking horticulturists understand that it is not only critical to develop sustainable growing methods, but in order to feed and treat a growing population, it is also essential to make sure sustainability also means increased productivity.

In the lighting world, there's nothing more high-tech than LEDs. LEDs are, at their essence, integrated circuits built on semiconductors, very similar to the microchips that power your smartphone, your laptop, your television, your car… you get the idea. LED microchips are based on the same groundbreaking technology that was developed by brilliant engineers nearly 60 years ago and revolutionized everything about the way we live our lives.

On a fundamental level, a semiconductor is a substance, usually a solid chemical element or compound, that can conduct electricity in some cases but not all. This "semi-conducting" property is an efficient way to control electrical current and enables millions of electronic operations to take place in a tiny space.

LED semiconductors are "grown" in a process wherein alternating layers of positively and negatively charged semiconducting material are deposited on a substrate material such as sapphire. When the LED is complete, electrons flow between the negative and positive layers, generating light.

As demonstrated by the enormous number of applications for microchips, these tiny electronic "brains" are highly adaptable and can be designed to achieve a wide variety of

outcomes, and for a number of reasons, LEDs are quickly becoming the ideal lighting choice for indoor and greenhouse horticulture.

Spectral composition

Research and development over the past 50 years has led to the ability to customize spectral output of LEDs by using different semiconducting elements. For example, the use of indium gallium nitride (1nxGa1-xN) results in an LED that emits blue light, while using gallium phosphide (GaP) will make red light. Additional elements can be precisely applied to further refine the exact wavelength emitted.

The ability to produce a precise and specific wavelength — down to the nanometer — is changing crop production on a global scale. Sophisticated growers enlist particular spectral combinations in order to elicit specific light mediated responses (increased biomass, shorter internodal spacing, trichome development, flavor manipulation, or induce reproduction) from their plants.

Energy savings

According to the U.S. Department of energy, LEDs typically use 75% less energy than many legacy lighting types, and this incredibly efficient light source is able to convert more than 50 percent of the electricity it uses into light.

Furthermore, LEDs generate far less heat than other lighting sources, meaning huge HVAC savings, too. Controlled-environment ag farmers using traditional lighting must install expensive cooling systems to remove the extra heat generated by those older lighting systems. LED-lit farms require simple fans, if anything, to keep their plants cool and comfortable.

From small grows to large, saving energy is beneficial not only for your ledger, but for the environment, as well.

Longevity

High-quality LEDs, like those we incorporate in our systems from Osram and Samsung, have a lifespan of up to 100,000 operating hours, as compared to HPS lamps, which have a lifespan of about 10,000 hours. Metal halide will last between 16,000 and 20,000 hours, but see light output reduced by 50% at around 10,000 hours. Solid-state LEDs, of course, don't have bulbs that break or need frequent, expensive bulb changes as do the legacy lighting types. LEDs furthermore don't contain environmental hazards such as the mercury found in other systems.

LEDs have zero moving components and are much more durable than other lighting systems.

The time is right

Fits and starts plagued the LED grow light industry in its infancy, as happens with many new technologies. Just like the first computer wasn't capable of streaming 4K video or mapping the human genome, the first LED grow lights simply weren't capable of performing at a level the commercial industry required. It wasn't a fault of the technology at the time, but was rather the fault of misdirected sales and marketing strategies overpromising the capability of these systems.

Another consideration: All LEDs are not created equally. Cheap components that can be purchased off the shelf should not be confused with the high-end, custom-manufactured LEDs used by Fluence in our lighting systems. We work with LED specialists to build LEDs that meet our exacting standards.

Fortunately, consistent R&D and careful sourcing has solved the issues seen with early LED tech. Years of improvements and years of experience have combined to mature the industry to a point where hundreds of indoor grow operations around the world have successfully adopted and embrace LEDs.