Split Electrode Electroluminescent Lighting Eliminates Glare Pollution

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The evolution of lighting in cinema and theater design has seen many changes over the years. When candles were the mainstay for lighting, the primary function was to help one navigate in darkness. They worked well for this purpose, as they cast enough light to see while walking, yet not enough light to distract other patrons. However, candles are not ideal for safety reasons, but because of the era, this was the best option.

As always, one invention leads to another, creating new technology platforms. With the invention of electricity, lighting was one of the big beneficiaries. From the electric light bulb to fluorescent lighting, to now LEDs, each generation of light produced many more lumens than the last, and always at lower energy consumption. From fire burning torches to LEDs, lighting is constantly evolving in pursuit of more brightness with lower energy costs. Each generation of light in a way becomes greener.

During the same evolution of light, the demand for lighting in cinemas changed. Lighting is needed to highlight hazards, provide soft illumination for egress and for interior design accents lights. Cinemas are more than just a place to watch a film, they are an experience. More lumens at a lower energy cost should not be the priority when designing a modern cinema. Illumination is not about visibility any longer. Low energy lighting is important, but higher lumen count is not the right direction. Creating more light for the least amount of energy has always been the goal.

Finding a light source that is very visible but does not produce unwanted lumens is difficult. Historically, most light sources were developed as a task light. Their brightness and ability to illuminate an area was measured in illuminance, which records the light striking a surface. One would hold the light meter towards the source to measure the illuminance of light.

In accent lighting applications today, you are measuring the reflective light off the surface, which is called luminance. This is the light that comes back to the viewer’s eyes, basically surface brightness. This is also considered the human perception of brightness, or how bright we perceive the light that is reflected off the surface. The intent is to produce a rich bright color with most of the light contained there. You can have the most powerful bulb in the world, but if the light needs to be diffused and you only see 10% of it. 90% of the bulb’s capacity is wasted. This is what happens with LEDs.

In theater illumination, the primary use of lighting is not only safety, but to create a warm and inviting atmosphere to enhance the experience. The primary challenges of cinema design are to produce even lighting with null light pollution, and ideally with zero light on the screen. The new HD 4K cameras of today deliver unprecedented image clarity. It would be a shame after that investment to ruin the image with cast light.

Cast light is where LEDs struggle, as they produce so much light that they must be diffused. Diffusion has two purposes - to block as much light as possible, and to make the surface lighting appear even. Diffusion is not an easy task when you are working with small bulbs capable of illuminating a warehouse that are spread out along a linear path with a lens to look like one continuous light.

When one technology reaches a new plateau, other technologies tend to benefit. In many cases, the shift toward new technology demands for attributes that are no longer desirable from the incumbent. The primary reason we don't use candles as a main light source is not brightness as much as safety. The demise of fluorescent bulbs was not just due to efficiency. The mercury and phosphorus inside fluorescent bulbs are hazardous. When fluorescent lamps are broken, a small amount of toxic mercury can be released as a gas, contaminating the surrounding environment.

As lighting technology has evolved, LEDs moved to the forefront as the solution that would replace all other lighting for theater design - not only for their amazing brightness but extremely long lifetimes with very low energy consumption. For many lighting applications, this still rings true as the best light source, especially for task lighting.

At the same time, for accent lighting, other attributes weigh more heavily. Even illumination with a proper light containment rate is quite important. It nearly goes without saying that energy savings is also a key attribute of accent lighting.

Two of the most important attributes as an accent light are also the hardest for LEDs to achieve. As time would tell, LED bulbs do not last forever and fail at different rates, a disaster for accent lighting that creates dead spots. Light pollution also became an issue as camera systems have improved and customers expect the best images. LEDs seemed like the best choice at the time for cinemas. But LEDs are better suited for general illumination where total brightness and energy consumption are paramount, not for gentle accent lighting.

Today, the demands in modern cinema design are in perfect alignment with the attributes of electroluminescent lighting. Electroluminescent lighting, also known as EL, offers the perfect balance of safety and elegance. The entire EL lamp is coated with phosphors, which results in the entire surface being a light source, not a series of single point bulbs. It is now possible to have even illumination without diffusion. EL lamps are extremely visible but at the same time, produce very little unwanted light. Most of the light is contained at the surface which is the principal goal of an accent light.

History of electroluminescent lighting technology

Electroluminescence (EL), or the generation of light by the electrical excitation of light emitting phosphors, has been around for many years. Electroluminescence was first observed in silicon carbide (SiC) by Captain Henry Joseph Round in 1907. Round reported that a yellow light was produced when a current was passed through a silicon carbide detector.

The next recorded observation of Electroluminescence of any great significance came at the time of the Second World War, though there had been various reports of work done in this area during the 1920's and 1930's. In 1936, George Destriau once again noted that Electroluminescence could also be produced from zinc sulphide (ZnS) powder after applying an electrical current to it, producing light. It was said that it was Destriau who first coined the word "electroluminescence" to refer to the phenomenon he observed. Destriau, who worked in the laboratories of Madame Marie Curie in Paris (the Curie's being early pioneers in the field of luminescence because of their research on radium), published a report of his findings.

During World War II, a considerable amount of research was done on phosphors in connection with work on radar displays, which was later used to benefit the television industry in the form of better cathode ray tubes. Wartime research also included work on the deposition of transparent conductive films for de-icing the windshields of airplanes. That work was later used to make possible a whole generation of new electronic devices.

After the second world war, there was a focused development of the phosphor light source driven by consumer applications, mainly as a backlight for liquid crystal displays. Timex Corporation would lead much of the initial commercial application development of electroluminescence with the Indiglo watch. The EL would illuminate the watch for nighttime viewing. Motorola also invested heavily with their initial Razr flip phones, with EL being the main backlight versus OLEDs now. Both products were adopted heavily, commercially benefitting EL development. [#1]

For years, there was very little development in phosphor technology. Until the world began to focus on OLEDs. Brightness limited the number of applications possible for EL, which began the starting point for phosphor development. The first-generation products that employed the much-improved phosphors were the plasma television. One significant development was glass encapsulation which protected the light source from moisture. Phosphor particles could be coated with the result of phosphors being brighter and lasting much longer, making plasma televisions a viable technology.

During that period, there were significant increases in phosphor brightness which in the end translates to much longer lifetimes. The phosphors could be driven at a lower input, greatly extending lifetimes. Conductive touch screens also made large strides with Eastman-Kodak leading the way. The front electrode of electroluminescent lamps requires conductive indium-tin-oxide (ITO) films to carry the current and complete the circuit. For some companies, the new materials made producing a more commercially viable lighting solution with lifetimes over 40,000 hours achievable.

Some companies, such as Electro-LuminX Lighting Corporation who manufacture Light Tape® lamps, have further developed the electroluminescent technology platform. They focus on process IP, as well as chemistries and associated electronics. They are not only a dedicated manufacturer, but also a leading product developer in electroluminescent technology.

E-LLC utilizes their own proprietary and patented binder system that has many benefits. This is the 'glue' that holds the phosphors and other materials together as one solid state lamp. They employ a high-quality roll-to-roll process producing the longest electroluminescent lamps in the world. E-LLC also has a very sophisticated line of power supplies that can be remotely dimmed and controlled by DMX512 or 0 – 10 VDC dimming.

Light Tape® offers the extreme visibility without unwanted light pollution.

The goal of accent lighting in a cinema is the ability to be seen. There are two ways to measure visibility for lighting, luminance, and illuminance. They may sound the same, but they are two completely different measurements. Luminance is the perceived brightness or ability to see something. For example, a laser would be high in luminance but low in illuminance; a laser is not going to light up a room but is very visible. The second measurement of lighting visibility is illuminance, which is the amount of light that is cast onto a surface or how much you light up a room, designed to measure task lighting.

For accent lighting, the most important attribute is surface visibility, the perceived brightness. How bright does an accent light on a step look, can it be seen? This differs from a light with high illuminance, where the intended light from the fixture is designed to also illuminate the room. In that case, how much light is cast past the surface of the step is measured. At some point the lumens can be so high that the light source becomes hazy and produces a glare. When compared to an LED light source, EL is crisper and can be seen in much worse conditions than an LED.

The United States Air Force conducted a study to determine which lighting technology was easier to see from great distances to help with navigation. The USAF wanted to determine which light technology performed better for navigation, evaluating electroluminescent (EL) versus light emitting diodes (LEDs). The study was conducted by Chesley S. Pie, a Major in the USAF.

“In April 1980, in response to a military Airlift Command runway lighting defiance report, an EL runway lighting system was assembled and installed in Holland, a 3,000 foot landing zone located at Pope Air Force Base…. The LED Elco lights were also installed so that a direct comparison could be made between the two systems. C-130 aircraft made assault landing, first with both sides LED, then one side of the field LED, the other EL, then both sides EL.

The results of the test were:

- The EL lights could be seen at 5 to 6 miles away versus 1 to 1.5 miles for the LED.
- Acquisition range of EL lights was not noticeably reduced during dust and haze conditions.
- The EL did not glare, which eliminated pilot blinking during round-out and touchdown.
- EL was seen through dust caused by reversing prop pitch after landing, the LED was not.
- EL provides a good tunnel effect.
- EL approach lights provided an excellent roll bar.
- EL did not flicker or give the indication of motion.
- EL lights did not have a halo, they appeared clean and the shape of the fixture.

Additional tests were accomplished with different frequencies and smaller EL lights to determine the effect of size reduction on acquisition range. Lights as small as 4 inches by 8 inches were used with no appreciable reduction in acquisition range.

The EL was subsequently tested in Alaska during January 1981 as the primary lighting system for BRIM FROST 81. The result paralleled those at Pope AFB, with the systems being acquired at more than 3.5 miles during blowing snow, tundra, and ice fog. The field was only closed once when the ceiling was reduced to 150 feet (ceiling limit for safety), even though the aircrews had a good runway presentation.” [#2]

Major Pie noted that ‘most lighting systems are designed around brightness, but it is becoming increasingly clear that brightness is not necessarily the optimum design point.’ In settings where the ambient light is low, electroluminescent lights are extremely visible. They provide excellent contrast and clear delineation with no glare.

Electroluminescent lights not only reduce glare and light pollution; they perform better with respect to visibility when called upon for egress applications. Egress wayfinding is an application where more lumens are not better, but the type of light source is more valuable. Electroluminescent lights outperform LEDs in smoke and fog being more visible in emergency situations.

Why Light Tape® electroluminescent lamps produce no glare versus LEDs

The wavelength of Light Tape® Lamps are very narrow and falls in the middle between infrared and ultraviolet light, containing neither. As a result, the light source registers with one eye as a crisp light, not fuzzy. Whereas LEDs have a bimodal wavelength. The double ‘wavelength hump’ is a major contributor to why LEDs produce a glare, and the light appears hazy, not crisp. This is not an issue for indirect view task lighting such as warehouse illumination. However, for direct view accent lighting, the haze becomes a problem to the viewers eyes.

For accent lighting, you look directly at the light source. When the light source is bright like the sun, staring at the source causes your pupils to constrict. This sensitivity to light produces a glare that ultimately reduces visibility. Using an LED as an accent light leaves creates this response. The light source becomes too harsh for the viewer, leaving them with hazy vision. It has been noted on several occasions that LED lights can be too bright, making navigation difficult for visually impaired patrons.

One interview performed at an IMAX theater discovered that when the step lighting was changed from LEDs to Light Tape® there was a visibility benefit. When the LED system was in service, several workers at the facility would not go into the theater during production. They found the LED light source made it difficult to navigate. They were very challenged by the stairs with LED lighting. Because the haze of the light source made it difficult to delineate a step edge and find the step base, the bright LED lights did not aid in navigation.

Once the Light Tape® EL system was employed, they found the light source made it much easier to navigate. Each step had a clear illuminated line, and there was very little cast light off the surface. This allowed the patrons eyes to adjust without over stimulation. Now, patrons and employees can walk the steps with confidence. The EL light served as a guide to mark the steps, and any cast light stayed on the surface, not reflected to the viewer's eyes.

A big challenge with LEDs is the reflection of the light source back at the viewer. The light does not stay on the surface but bounces off at angles, reflecting off other surfaces. Electroluminescent lighting does cast light, but not at a wavelength that reflects off surfaces. The light stays where it is cast, illuminating the intended surface.

Light Tape® produces even illumination by design versus LEDs must be diffused.

The major difference between LEDs and Light Tape® is the type of light source. LEDs are single point light sources, like a traditional light bulb in your home. To make 10 LED bulbs in a row appear as one, one would need to use a diffuser which is usually a thick plastic lens that blocks most of the light, what light is left all blends to appear as one giant bulb.

To achieve even illumination with an LED is not too much different than the lamp shade on your side table. The traditional light bulb is not pleasing to one's eyes. A lamp shade is employed to diffuse the light to create a glow. For an LED to act as a subtle accent light, the same basic diffusion method is utilized on a different scale. To make the lighting look even, the spacing between the LED bulbs must be close together. Too far apart gives you dark spots and too close together is too much light. An opaque lens is placed over top to block most of the light and make the surface appear even.

This can be effective, but the additional cost of the extra LED bulbs and lens can be significant. Additionally, a cavity must be formed to recess the LED bulbs far enough back from the lens to allow the diffusion to work properly. It is also important to factor in that the LEDs fail at different rates. It may not be long before one of the bulbs fails and the lighting can no longer appear even.

In many cases, LEDs are used within fiber optic cables to produce the light. Over time, the LED light source end will become hot and melt the rubber, which reduces the ability for light to travel through the damage ends. This ultimately makes one side brighter than the other as the cast light cannot carry evenly to the other end. Also, the LED can shine into the patrons' eyes and will interfere with 3D glasses as it is pointed directly at them while seated.

With Light Tape® EL technology, the entire illuminated surface is coated with phosphors and when powered, the entire light source illuminates. The surface is the bulb and there are thousands of small phosphor particles being illuminated to appear as one. Light Tape® offers the capability of having long continuous lengths of light of 30 meters or more and just one connection, one light source tuned to the perfect brightness. There is no need for a diffuser with Light Tape®.

How does the Light Tape® technology compared to LEDs?

LEDs and Light Tape® are both capacitive loads and release energy as a packet of light, better known as a photon. LEDs store and release energy by passing a slightly resistive 12 VDC current inside a silicone semi-conductor. However, heat is produced within the LED device itself, due to the inefficiency of the semiconductor processes that generate light.

Alternately Light Tape is a pure capacitor and extremely energy efficient. Split electrode lamps have two electrodes and only one side is illuminated at once, but this happens so quickly that the human eye cannot register. There is no resistance - as the electrons flow into the lamp, they come in contact with phosphors who temporarily store their energy and then release when switched off. Therefore, Light Tape is off half of the time.

What makes Light Tape unique is the light source phosphor layer is very 'thick' compared to other EL lamps and the power systems are very sophisticated. The power systems deliver clean power with little noise and much lower switching which greatly improves efficiency. Versus many EL systems that have a very thin phosphor layer and a very high switching power supply.

One way to compare EL operations is to relate them to a charcoal grill for cooking. The more coals one puts on the grill the greater the heat of the fire when lit. The more coals usually translate to a longer lifetime as there is more energy to consume before extinguishing. If the oxygen level is kept a low, the coals will burn slowly, not as hot, but for a longer period. If one was to fan the coals, and add more oxygen, the coals will burn hotter but not last as long.

Very similar to a basic EL lamp operation. If there is a very thin layer of phosphors inside the structure, this is like a thin layer of coals at the bottom of the grill. And if you were to switch the EL lamp at a very high frequency, this is similar to fanning oxygen on the coals. The faster you fan, the hotter and more intense the coals, but the quicker they will burn out. It is possible for an inexpensive EL lamp to be somewhat bright. But over time, the lamp will burn out much quicker due to the low phosphor count and intense operation.

A EL industrial grade solution like Light Tape has the highest quality and the most phosphors inside the structure. Over time, power can be increased sending in more electrons to collide with the phosphors to maintain brightness.

Light Tape® technology is a true solid-state technology compared to LEDs

Light Tape® composition is a series of coatings applied on top of each other that are dried into one structure. There is no gas, liquids, or filaments to break to cause Light Tape to stop working. The bond between each layer of a Light Tape lamp is indestructible. It is impossible to separate them as they are coated and cured as one. They produce no heat during operation. Once energized, it is impossible to cause the structure to fail. The Smart Driver™ power supplies are extremely reliable.

There is nothing solid state about LEDs other than the semiconductor chip itself. LEDs tend to fail by design as there are many points of failure supporting the chip. The heat LEDs produce can cause them to break from their heat sink due to epoxy degradation. The thermal stress can also lead to failures in the circuit caused by mechanical stresses on the semiconductor and the bonded contact. The quality of the parts used to create an LED fixture can greatly determine who the light source handles heat and stress. Not to mention, LED drivers are notoriously undependable, failing often.

Form factor, endless design options with Light Tape® electroluminescent lighting

LEDs are small silicon wafers on a metal ribbon which are relatively flat. However, they produce a load of heat. In turn, they cannot be designed into tight spaces without provisions for ventilation. Also, flexing or bending an LED ribbon can cause the LEDs to release from the electrode and fail. LEDs generally come in small sections and are linked together which limits the total length in one run. LEDs also requires more power supplies. There are quite a few design considerations to consider when designing with LEDs, including designing around heat, numerous power supply drops, and more.

Split electrode EL lamps do not have the same limitations. For one, they are flatter than a credit card and require no diffusion. Electroluminescent lamps produce no heat, so they always remain cool to touch. As mentioned, they can cover 30 meters or more with just one connection at the end of a single run. One power supply can illuminate a hundred meters of split electrode EL, making it possible to illuminate and control an entire cinema with just one transformer, which can be installed in the projection area and controlled via the camera system.

Energy savings of Light Tape® versus LEDs

An important thing to remember when comparing Light Tape® and LEDs for accent lighting is that most of the light produced by LEDs is blocked through diffusion. The light that does go through contributes to light pollution. While bright, up to 90% of the light produced by an LED for accent lighting is wasted energy.

At the same surface brightness, Light Tape® will consume 10% of the energy that an equivalent LED fixture would consume at the same width. Light Tape® energy consumption is based on the area that is illuminated; it is a capacitive load. EL lamps only require the energy to fill the load or surface area, and when switched off they release the energy as a photon or packet of light. The larger the area, the more power needed, it is a very linear relationship.

On the other hand, LEDs are a resistive load, which is why they produce heat. Energy is passed through the silicon wafer producing heat. The silicon wafer differs from lot to lot, which is also as sign of their variability. The LED system is more efficient than other resistive loads. When thousands of lumens are needed, LEDs are the most efficient in producing light.

For applications like step lighting, which are narrow and accent light by nature, a Light Tape® system will consume on average 0.25 watts per meter for an EL lamp that is 6.35 mm wide and a meter long. A LED strip to fill the same fixture will consume 4 watts a meter or more in many cases. The energy savings is magnitudes less with Light Tape®.

The operating cost of a 50-step venue using split electrode EL is $6.50 (USD) per year, compared to $78.50 for most LED systems. Not to mention the environmental impact on the air conditioning system to compensate from the heat produced by the LEDs.

Is profile design important?

The light source is the most important part when it comes to ambiance and performance. But the profiles that hold the light source are very important, as well, especially with respect to reliability.

Traditionally, many profiles are made from plastic and are cut on site. They are usually adhered into place using tubes of silicone and generally are not mechanically fastened. When mechanical fasteners are employed, they are done via the top and the screw heads are left visible. Over time, the end caps come off with cleaning as the silicone will fail.

Electro-LuminX® changed how step lighting is manufactured and assembled. StepGuard™ profiles are made of aluminum and are very durable. The system is adhered to the step from the top with the use of mechanical fasteners. The screws are then covered with an anti-slip rubber insert that not only hides the screw heads but adds a layer of protection for the pedestrian.

StepGuard™ end caps are made through an injection molding process and fit the ends of the extrusion perfectly. They are mechanically fastened with small hidden screws, no need for any glue. The Light Tape itself sits inside a rubber insert to further protect from moisture and provides an IP65 rating. Each step comes with two wires and is ready to mount. Taking installation times down by 75% compared to traditional systems.

EL viewing angle accentuates brightness and visibility

Electroluminescent lamps produce light at nearly a 180-degree plane. Light leaves the surface at thousands of angles, making viewing possible at a wide angle. Plasma televisions enjoy a wide viewing angle due to the light source.

Electroluminescent exit signs are better than LEDs for this reason. The brightness can be tuned lower to prevent light pollution on the screen. At the same time, the viewing angle for patrons to see the sign is super wide, making it ideal for egress situations.

What have been the challenges for electroluminescent technology?

The original focus nearly two decades ago in the early 2000s was the development of OLEDs for television, increasing brightness. In the beginning of this period, there were significant advances in phosphor technology. One was the development of glass encapsulated phosphors, which protected the light source from moisture. The resulting phosphors were also brighter and lasted much longer, making plasma televisions a viable technology. Brightness limited the number of applications possible for EL until the development of the plasma television.

Another challenge in the past is the harmonics emitted by electroluminescent lamps. Original power supplies were analog in nature and produced a very choppy sine wave. At high frequencies, the sign wave would produce a hum. Over time, companies like Electro-LuminX Lighting Corporation improved the power supply technology, producing digital power supplies. Digital power supplies eliminated the audible noise, especially for large format where harmonics were an issue. Parallel plate El lamps still have some noise, but largely due to a poor-quality phosphor being illuminated at a very high frequency to maximize what little brightness existed, resulting in a high pitch hum. For novelty applications, most still utilize antiquated analog control technologies.

Long runs were also a challenge with most electroluminescent lamps being silk screened, a low form of printing phosphors on conductive materials. To achieve long lengths over a few meters, it was necessary to ‘join’ small sections together as one longer piece, which posed issues with safety due to the electrical splices. But with the advent of roll-to-roll manufacturing, it is now possible to make continuous rolls over 300 meters in length and widths well over one meter. Split electrode lamps, once again manufactured by E-LLC, lead the way here.

The final challenge for electroluminescent systems is the ability to remotely control the brightness. In the early days of EL, brightness had to be controlled manually at the power source. The electronics were largely unsophisticated with the primary control being able to turn off and on. Most power sources were not able to easily integrate into common control systems.

Today, E-LLC has a platform of power supplies that can operate from a variety of inputs. They can be tied into battery backup systems, accept AC or DC input power, and all can be digitally controlled, especially those found in movie theaters which require dimming protocols such as DMX 512 or 0 – 10 VDC.

Things to consider when evaluating electroluminescent manufacturers today

There are two predominant types of electroluminescent lamps produced today - parallel plate and split electrode technology. Parallel plate is produced via a batch process where split electrode is a roll-to-roll continuous process. Split electrode lamps usually have a continuous coating on the back with a narrow line down the middle to split the electrode. The entire structure will appear as one. With a parallel plate lamp, the rear electrodes are glued on versus coated.

For many decades, the most common manufacturing method for EL lamps has been silk screening, the same technology known as parallel plate EL. A very straight forward raw technology, the same employed to make printed t-shirts via a combination of chemical and mechanical bonding. Each layer is placed on the previous and then squeegeed off. This is a helpful technology for making small parts or novelty products.

One major downside of the silk-screening process is the coating process itself. Generally, a very thin layer of phosphors is placed on the conductive ITO film. In most cases, a very low-grade phosphor is used which significantly reduces the cost. The less phosphors used, generally the duller the lamp. One will be able to see the granularity of the light source due to the relatively low deposit of phosphors and quality, which will become more noticeable as the point sources fail due to the thin coating. For many applications, like signage for beverage brands in the convenient store or an illuminated hat, this technology works well as desired lifetimes are shorter.

Parallel plate lamps require more energy to illuminate and operate at very high frequencies. The high switching keeps the phosphors at an elevated state, much like fanning a charcoal grill. However, the elevated state greatly reduces lifetime.

Generally, parallel plate lamps also called bus bar, utilize very low-grade phosphors which are not glass encapsulated. The phosphors will appear bright when first illuminated. But without the glass encapsulation, they are very susceptible to moisture and will begin to degrade quickly. It is important to identify the technology differences as the poorer results may not be apparent when sampling.

Another major difference is the rear electrode for parallel plate technology, which has two major drawbacks. The electrode is mechanically bonded to the rear of the lamp meaning that it is not bonded like a paint, but glued. Over time, the electrode can separate from the front electrode and cause shorting which happens as the glue from the bond fails and releases the electrode. Shorting especially happens if there is any impact, bending or kinking of the light source. The second is the rear conductor is made from poorly conductive materials such as carbon, not precious metals which are far more conductive. The more conductive the front and rear electrode, the better an electroluminescent lamp will perform.

Parallel plate silk screened lamps are also limited in length. The processing equipment can only produce lamps a few meters long at most. While sometimes they are sold in long lengths, upon careful review, they are small sections joined together to form a long one. The danger of this solution is each section can separate and produce electrical shorting as they fail.

On the other hand, split electrode technology is made using a roll-to-roll process. Each layer is chemically bonded to the previous layer. This produces a strong bond that will not separate as with parallel plate lamps. Each layer is 'painted' on top of the preceding layer, which forms an indestructible bond. Split electrode lamps can be aggressively flexed and take abuse. The energy efficiency is greatly improved due to integrated chemistry.

For split electrode lamps, there are also differences in how the energy flows. The roll-to-roll process does make a more uniformly layered lamp. Also, it is possible to put down a much thicker layer of materials, unlike a printing process. A heavier phosphor coating and a thicker rear electrode greatly extend the lifetime of the lamps. The long and continuous process makes a more efficient lamp that is very uniform. At the moment, E-LLC is the only company in the world that employs a continuous roll-to-roll process.

In addition to the coating process, as mentioned, the phosphor light source is very important. Electroluminescent technology utilizes inorganic phosphors. They are generally available in only a few colours, but can be filtered to produce a wide spectral range. There has been considerable development to produce organic phosphors, like used in OLEDs. However, today that technology is only employed as a backlight or a fixed light source.

The challenge that both EL and OLED phosphors face is the presence of moisture will destroy the light source. OLED is magnitudes more vulnerable to moisture and air. An OLED must be made under very strict clean room applications and generally built into a rigid system to maintain the barrier to moisture.

Alternately, high quality EL phosphors are glass encapsulated, which protects them from the environment. Most EL manufacturers don't use these as the light source due to high cost compared to low grade options. In many applications, the lifetime is not important, thus the higher quality is not needed. A commercial grade inorganic phosphor is 10 times more expensive than the novelty grade.

Electro-LuminX® Lighting Corporation (E-LLC) utilizes a patented fluoropolymer binding system. This is the coating that is used to suspend the phosphors during the manufacturing process. This system provides excellent bonding to the conductive surface and additional protection from moisture. As a result, lamps produced by E-LLC will maintain their integrity for decades.

E-LLC also uses precious metals, such as silver bought on the mercantile exchange, as the rear conductor. This precious metal is by far the most conductive material used today as a rear electrode. The result is much better conductivity, resulting in lower operating power and much longer lifetimes. To illuminate large areas and long lengths, highly conductive materials are needed to carry the current.

Another benefit of the patented E-LLC technology being a continuous roll to roll coated process is the ability to make extremely long lengths. The roll-to-roll process is much more efficient than batch, like in silk screening. E-LLC's lamps can operate in continuous lengths up to 50 meters with a single connection and power source.

Electro-LuminX® Lighting Corporation holds patents in safety, virtual reality, chemistry, billboards, OEM applications, roll-to-roll, novel chemistry, while other EL manufacturers are focused on producing via silk screen process with low quality raw materials.

In summary

The technology shift to 4K high-definition cameras has changed the way cinemas are designed and used today. From amazing sounds systems to luxury seating. Designers strive to create fully immersive environments to enhance the cinematic experience as customers demand more from the price of a movie ticket. As a result, almost every aspect of a cinema has been reimagined, challenging the current interior product offerings to meet the new cinema environments.

Super bright LEDs do not fit into the new cinemas of today for many reasons. The first and foremost being the technology was developed as the next generation task light. Designed to produce incredible amounts of light while reducing energy costs. As it turns out with many new technologies, the drawbacks are not immediately understood. LEDs did lower energy costs. However, the bulbs fail at different rates and are not designed as an accent light. They are unable to provide even illumination without aggressive diffusion, and before long lead to spotty accent lighting at best. LEDs cause light pollution with their cast light reaching the screens and cause a glare. Also, disturb patrons with bright lights in their peripheral vison while viewing the movie.

Electroluminescent lighting has been around for nearly a century with even illumination and zero light pollution or glare. In recent years, improvements in the phosphor and manufacturing technologies have significantly improved lifetimes with current installations lasting more than a decade. The split electrode electroluminescent technology offers the most promise as it employs roll-to-roll manufacturing process versus batch printing like parallel plate technology. Electroluminescent lamps produce no heat, have completely even illumination and are extremely energy efficient. Some manufactures, like Electro-LuminX® Lighting Corporation also offer fully dimmable and controllable power systems. Their technology can be tied into camera systems utilizing DMX512 or 0 -10 vDC dimming control.

There are hundreds of LED manufactures with greatly varying quality. It is time now to evaluate electroluminescent technology to meet the new demands in cinema design. EL does have varying levels of quality as manufacturers are not equal. But as with many products, doing your homework and comparing offerings, one can determine who produces the best offering and right solution for you.

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