PHILIPS

Backgrounder

PHILIPS IS TAKING THE NEXT STEP FORWARD IN LEDS AND OLEDS

OLEDs (Organic Light-Emitting Diodes) are the next step forward in the evolution of new light sources, generating light by semiconductors, rather than using a filament or gas. LED and OLED lighting provide illumination that is more energy-efficient, longer-lasting and more sustainable. It also opens exciting new doors to how we can use, integrate and 'play' with light in our homes, cars, shops and cities. In addition to Philips' expertise in LED it is now developing its OLED expertise.

LEDs and OLEDs – the difference

LEDs and OLEDs both generate light by semiconductors – basically by stimulating electrons in their components with an electrical charge. They also share the ability to create color effects that go beyond the ability of incandescent lamps. They both share the potential to become extremely energy saving light sources. But there the resemblance ends. There are a number of differences between LEDs and OLEDs in their make-up, the type of light they produce and the way they can be used, complementing each other in terms of application used.

Organic vs. inorganic – another type of light

A key structural difference is that OLEDs are created using organic semiconductors (such as those that make up organic solar cells), while LEDs are built in crystals from an inorganic material. There are also *visible* differences between these two types of solid-state lighting. LEDs are glittering *points* of light – in essence, brilliant miniature bulbs. OLEDs, on the other hand, are extremely flat *panels* that evenly emit light over the complete surface. The illumination they produce is "calm", more glowing and diffuse, and non-glaring. The thin, flat nature of OLEDs also makes it possible to use and integrate light in ways in different ways than LEDs can do – or any other lighting source for that matter. LEDs are excellent to create sharp beams, add drama and accent due to their compactness. OLEDs will never replace LEDs – they have their own very specific and useful types of application possibilities. The two, however, complement each other very well, providing different options in a new type of digital lighting that is becoming increasingly important in an energy-conscious world.

How OLEDS work

OLED lighting works by passing electricity through one or more incredibly thin layers of organic semiconductors. These layers are sandwiched between two electrodes – one positively charged and one negatively. The "sandwich" is placed on a sheet of glass or other transparent material which, in technical terms, is called a "substrate".

When current is applied to the electrodes, they emit positive and negatively charged holes and electrons. These combine in the middle layer of the sandwich and create a brief, high-energy state called "excitation". As this layer returns to its original, stable, "non-excited" state, the energy flows evenly through the organic film, causing it to emit light. Using different materials in the organic films makes it possible for the OLEDs to emit different colored light.

OLEDs today

Philips started researching OLEDs back in 1991, as part of its development of OLED display screens. The company began specifically focusing on OLED lighting applications in 2004. Since then, Philips has been at the forefront of new and rapid innovations in the field, which now have OLEDs poised to change the lighting world yet again. Philips were the first to make their Lumiblades commercially available in April 2009 and introduced easy to integrate OLED modules, a standard lighting panel together with a socket/base system: Philips Lumiblade module. Philips unveiled various OLED based concepts together with leading Designers during 2009 in Milan and London. We built on this success and are now showing the results of cooperations with various creative parties in our creative lab, based in Aachen.

Dramatic and unexpected

Even though Philips has just begun unlocking the potential of OLEDs, they already offer unique characteristics and capabilities that can redefine lighting, and the way we use and experience it. First, there is the subtly diffused – almost magical – nature of the illumination itself. OLEDs create soft glowing clouds of light, rather than bright rays. Then, there is their homogenous output, unusual appearance, low heat emission, extremely flat nature and high degree of controllability. These offer designers, artists, architects and others great freedom in creating groundbreaking new lighting concepts and experiences: ones that will greatly appeal to consumers by making it possible to change the atmosphere in a room in dramatic and unexpected ways.

Ready to produce

Philips already has various OLED panels available for commercial use as engineering samples. Recently, the company stepped up its efforts and the world's first-ever production line for OLED lighting in Aachen, Germany. This marks a significant step forward in advancing OLED technology in the crucial area of manufacturing. Because of this, Philips has been one of the first companies to make OLED lighting technology commercially available on a large scale. The products, which are marketed under the name of Lumiblade, will include OLED lighting plates of up to 50cm² in a wide range of colors and shapes.

OLEDs tomorrow

The advanced OLED-based concept experiences for consumer and professional use demonstrate what is already possible today. We can expect to see designers, architects and consumers increasingly using OLEDs in a variety of contexts over the next few years. Research and development continue at top speed, conquering new and unexplored territory. Imagine ceilings glowing with color, glass walls that light up at the wave of your hand, or windows that provide subtle illumination after dark. The result is large areas of evenly distributed light that can be adjusted in brightness and color and can be applied to almost any surface in almost any shape. This is the exciting world of the OLEDs of the future.

Invisible light

Today, OLEDs generally have a reflective, mirror-like surface when not illuminated. Another current area of research is on the development of completely transparent OLEDs, which will open many new doors in application possibilities. Transparent OLED panels will be able to function as ordinary windows during the day, and light up after dark, either mimicking natural light, or providing attractive interior lighting. During the

day, they could also function as privacy shields in homes or offices. Look out for transparent OLED panels within the next 3-5 years.

Beyond illumination

The OLEDs currently available are mounted on glass. So far, glass is the only transparent substrate that sufficiently protects the material inside from the effects of moisture and air. However, we are investigating ways to make soft plastic substrates that will provide the necessary protection. This will open the way for flexible and moldable OLED lighting panels, making it possible for any surface area – flat or curved – to become a light source. We could see the development of luminous walls, curtains, ceilings and even furniture. Flexible OLED panels are likely to become available within 5 to 8 years.