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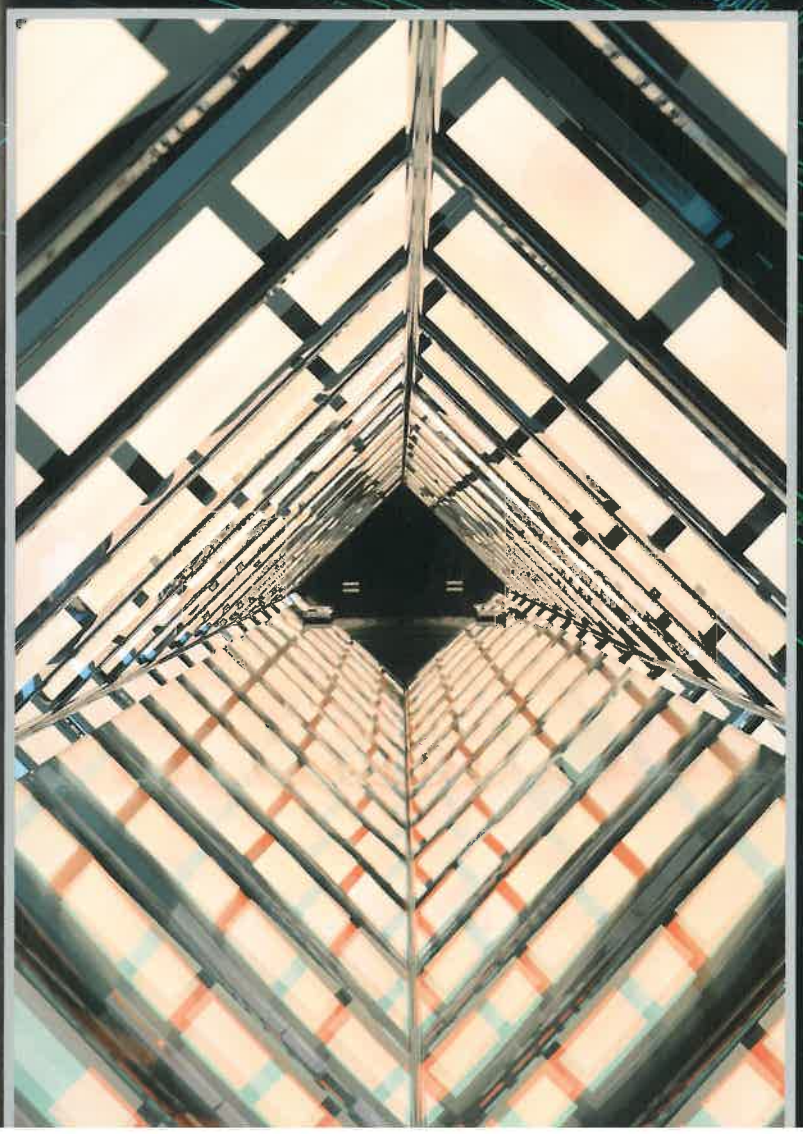

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Shedding some light

Lifetime and efficiency are currently at the core of OLED research and development

Just as in organic solar cells, performance improvement is one of the big topics in OLED technology because it will be a decisive factor in opening up bigger and attractive markets; and German-based Novaled is sure that its products can play a strong role in this developing market.

The company is developing materials for high performance OLEDs for display and lighting applications. The proprietary products include charge transport materials, conductivity dopants, interlayer materials for stacked OLED architecture, and optical-out-coupling materials suitable for a variety of OLED applications.

"Our OLED materials are designed to generate light with high efficiency at a low operating voltage in a stable device structure," says Dr Tobias Canzler, customer project manager at Novaled. "Typically 70% of the generated light is trapped in the OLED. Efficient extraction of the light is the next key step to improve OLED performance."

For this Novaled introduced a new product series using dedicated out-coupling materials to increase light extraction. Although Novaled's commercial materials have been used in vacuum process tools, the company now also offers a new generation of materials for solution processing.

"Our company is considered as an outstanding material provider, if only because we combine three different challenging skills – synthetic chemistry, device physics and processing know how," explains Dr Canzler. "The combination of all these skills enables us to support customers with tailor-made solutions. For instance, the chemistry of dopant materials is challenging because of the high reactivity of those materials. Synthesis of conductivity dopants sometimes pushes chemistry to its limits."

According to Dr Canzler, the design of OLED architecture is mainly the combination of the right material set for balanced electrical properties, optical design by adjusting layers and their thickness, and implementation of out-coupling approaches.

Finally, he mentions that the manufacturing of OLEDs requires a lot of know how: "OLED materials need to fulfil several complex processing requirements. For instance, vacuum and solution processing usually require very different material sets. We are experienced in all processes relevant to OLED manufacture. The cleanroom is set up with state-of-the-art tools, equipment and infrastructure."

Enhanced performance

One of Novaled's most important offerings is its PIN OLED doping technology. The basic architecture of doped and undoped OLEDs is similar. In contrast to conventional OLEDs, its PIN OLED technology, according to Novaled, introduces an additional degree of freedom for product design, considerably enhancing hole and electron-transport as well as charge carrier injection. As a result of doping, additional process steps, such as ITO treatment, are not needed.

"In addition, when using p- and n-doping, a much wider range of materials can be used for the anode and cathode," explains Dr Canzler. "As a result, OLEDs produced using our PIN OLED technology have a very low driving voltage and high substrate compatibility, while maintaining high power efficiency and long lifetime."

The main advantages this technology offers include improved OLED lifetime and efficiency. It also facilitates the use of cheap and flexible substrates and provides a high degree of freedom concerning electrode materials. Novaled has developed several doping and transport materials that can be used in OLED or organic photovoltaics to enhance performance and durability.

Shaping own products

But Novaled does not only produce materials for OLEDs, under the brand name Liternity the company also introduced a range of luxury OLED luminaires and lighting products. "With our OLED luminaires we offer the opportunity to experience innovative lighting, using state-of-the-art OLED technology and precious materials that are rarely seen in light design," says Gerd Günther, CMO of Novaled. "Liternity demonstrates the amazing potential of OLEDs for

innovative lighting products available for end consumers already today. Our intention is to pave the way for OLEDs as a commercial lighting source."

The first Liternity product series, Victory, uses carbon fibre as the fabric for its designs. Developed for aerospace applications, carbon fibre is lightweight, and can be ultra thin and flexible in terms of its shape-properties, which, according to Novaled, complement the distinctive attributes of OLEDs.

"We have received very positive feedback since the release of the first Liternity product, the OLED table lamp 'Victory' at the end 2011. At the Light & Building 2012 show in Frankfurt, the Victory was considered a great product," reports Günther.

"Meanwhile, the product has been nominated for the German Design Award 2012. Retailers, planners and architects seem to be interested in such products, especially in transparent (in off state) OLEDs for luminaires, a special feature of this lighting source."

Novaled decided to target the luxury end of the market for its Liternity product Victory. "Natural OLED light creates a visual treat, projecting creative light effects onto the open structure of the carbon fibre base. We worked with specialists on the design and manufacture," adds Günther. "Carbon fibre provides an unusual factor, allowing for ultra thin and bended forms. These characteristics complement the thin area light source OLED perfectly. "

Industrial outlook

According to Günther the lighting industry is facing a major restructuring with the advent of new lighting technologies.

Gerd Günther

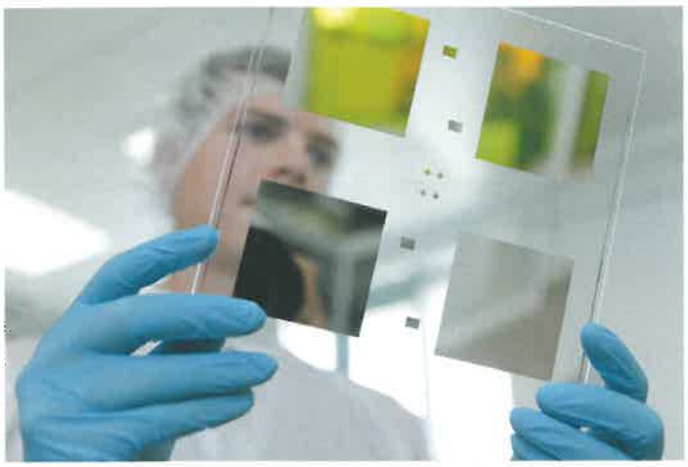
Dr Tobias Canzler

LED lighting is now used extensively in display backlighting and automotive applications, and poses a growing challenge to commercially established general lighting technologies such as compact fluorescent (residential), fluorescent (office), and high-intensity discharge (commercial) lamps.

OLED lighting is expected to play a significant role in the future lighting market, especially in design and architectural applications. Revenues for OLED lighting in 2018 are expected to reach about $6.2bn for producers (source: Display Search). The lighting market is highly concentrated at the lamp level and, in the case of general lighting, very fragmented at the luminaire level. The lighting products market comprises three major product areas: luminaires, lamps (light sources) and controls.

"Display Search predicts total revenues for OLED display in 2018 to be about $25bn at producer prices," adds Günther. "The display products market is highly concentrated with a few major manufacturers of flat panels and a number of major corporations serving the end-markets. The flat panel display market comprises three major application segments – mobile phone, personal computers and television. Although the dominant technology today is LCD, OLED is catching up."

An example for this is the famous iPhone, which still uses an LCD display. With its high quality AMOLED display many people think the Samsung Galaxy S3 has overtaken Apple's product in terms of display quality.



A Novaled specialist with OLEDs

Visual inspection of substrates in Novaled's clean room