

News Release

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May 8, 2017

Merck KGaA, Darmstadt, Germany, at SID: Future-oriented Materials for Displays and More

- **Established liquid crystal technologies becoming increasingly sophisticated**
- **Cooperation with Flexenable will advance flexible LC displays**
- **Great progress made in printable OLEDs**
- **Windows and antennas with liquid crystals will soon be market-ready**

Darmstadt, Germany, May 8, 2017 – Merck KGaA, Darmstadt, Germany, a leading science and technology company, will present new technologies for displays and visionary future projects at the Society for Information Display (SID) Display Week 2017. The company will exhibit its broad portfolio of products and services under the slogan “The Perfect Pixel – Advanced materials for displays and beyond”.

“In close contact with our customers, we refine our established display technologies piece by piece and hone the quality, reliability and service,” said Michael Heckmeier, Head of the Display Materials business unit at Merck KGaA, Darmstadt, Germany.

“In order to assert our position as a leading supplier in this dynamic market, we also continually work on new materials for displays and beyond. Making production processes more eco-friendly and efficient drives us just as much as offering end consumers a better user experience. In doing so, we aren’t thinking just about free-form, flexible, color-intensive, high-contrast and energy-efficient displays, but also focus on breakthrough innovations such as our liquid crystal window modules.”

High-resolution and resource-saving: optimizing classic displays

Based on all current technologies ranging from in-plane switching (IPS) to polymer-stabilized vertical alignment (PS-VA), Merck KGaA, Darmstadt, Germany, continuously develops and commercializes liquid crystal singles or mixtures under the licristal brand. One focus is on increasing light transmission, contrast, response

Page 1 of 5



and switching times, as well as outdoor readability. At the same time, Merck KGaA, Darmstadt, Germany, is aiming to expand the design possibilities and improve cost efficiency in display manufacturing. The energy-saving ultra-brightness fringe field switching (UB-FFS) technology has further strengthened its position in the market – especially for smartphones and tablets. Because UB-FFS makes better use of backlighting, it allows slimmer displays – at optimized light transmission and higher resolution. Currently, the technology is being further refined for non-mobile applications, such as for slim LCD televisions with extremely high resolution and reduced energy consumption.

The first commercial products with the new self-aligned vertical alignment (SA-VA) liquid crystal technology are expected to be launched in 2017. Similar to the established PS-VA liquid crystal technology, SA-VA is used primarily in large displays, such as in high-quality televisions, public information display panels but also in automotive applications. The new technology is very eco-friendly and resource-saving because it requires less energy, uses less solvent and has fewer process steps in display production. There is no need for a polyimide layer. Because the SA-VA technology can be used at lower temperatures, it is suitable for sensitive materials, for example in premium products or future applications such as flexible displays.

Robust, lightweight, and bendable: new LC display forms

Merck KGaA, Darmstadt, Germany, is collaborating with Flexenable of the United Kingdom to accelerate the development of free-form displays, following a recent breakthrough by Flexenable with conformable, large area, full-color and video-rate organic Liquid Crystal Displays (organic LCDs) on plastic. With a bend radius that can go below 30 millimeters, organic LCDs can satisfy the market needs for new use cases for example in automotive applications, where thin, conformable and shapeable displays are required. In the near future organic LCDs can be curved around even more complex surfaces and shapes by combining Flexenable's high-performance organic thin-film transistors with the innovative polymer wall LC technology from Merck KGaA, Darmstadt, Germany. These polymer walls can enhance cell-gap control while providing excellent display performance. Organic LCDs can be manufactured on conventional production lines.

High-contrast and flexible: OLED materials growing strongly

OLEDs were discovered 30 years ago. This anniversary will be formally celebrated at a symposium sponsored by Merck KGaA, Darmstadt, Germany, at SID's Display Week. OLED materials are gaining in importance today, especially in modern smartphones and high-end televisions. In displays they captivate with their brilliant colors, sharp images from any viewing angle, high contrasts and a perfect black state. In addition, they are thin, flexible and very energy-efficient. As a diffuse light source, they are revolutionizing the design of automotive lighting. In the future, they could also transform ceilings or walls in buildings into information panels. In order to realize these visions, Merck KGaA, Darmstadt, Germany, is developing highly efficient OLED materials under the livilux brand name for vacuum evaporation methods or printing processes. At the SID conference, the company will report on progress made in the development of printing inks. For the first time, printed red and green layers exhibit comparable efficiency values as in vacuum evaporation technology. This will allow flexible or rollable screens to be manufactured in the future, such as for automotive applications or large-area displays. The company continues to invest heavily in OLED technology and is excellently positioned. For instance, in 2016 it opened a new production plant for OLED materials in Darmstadt that enables production capacity to be increased fivefold. The capacities at the application laboratory in Korea are to be doubled in 2017. In order to further advance printing technology for new application areas beyond displays, Merck KGaA, Darmstadt, Germany, is also collaborating with partner companies. A current example is the cooperation with Inuru, a German start-up. Eco-friendly OLEDs are produced in a special printing process, and the initial applications are promising: print advertisements are impressive, and packaging lights up.

Innovative and high-quality: complete portfolio

Merck KGaA, Darmstadt, Germany, offers a broad materials portfolio for display manufacturers and satisfies the highest quality requirements. Thanks to reactive mesogens under the licrivue brand, high contrast values that ensure a perfect black state can be achieved in displays regardless of the viewing angle. Highly developed photoresists simplify the production of thin-film transistors of LC and OLED displays. The offering is augmented with silicon-based materials. Polysiloxanes have excellent planarization and electrical insulation properties that

improve light transmission. The company recently began marketing cadmium-free quantum dots under the livilux brand. They enable a remarkable increase in the color range, a significant reduction in power consumption and are also eco-friendly. High-quality phosphors are used for the backlighting of liquid crystal displays. Full-spectrum phosphors for LEDs with a violet chip are a new addition to the isiphor brand family. They are very luminous and achieve a high color rendering index and a spectrum that closely resembles natural sunlight.

Visionary and impressive: beyond displays

The development of new application possibilities for liquid crystals remains an important focus of our LC 2021 strategic initiative. This primarily includes the development of liquid crystal window technology. In order to protect against solar radiation, these windows allow continuously variable switching from light to dark in just seconds and have high color neutrality compared with competitive technologies. The privacy variant of the windows allows switching from transparent to opaque. Application areas for the materials marketed under the licrivation brand name include buildings and vehicles. In addition, good progress is being made in the development of smart antennas, which are also in demand in the automotive industry and are expected to reach market readiness in 2017. Thanks to a thin functional layer of liquid crystals, the antenna can be electronically pointed to satellites without the need to move the device mechanically.

At the international symposium held during SID Display Week, Merck KGaA, Darmstadt, Germany, will be presenting its latest research and development successes in various informative lectures:

- Monday, May 22, 2017, 4:25-4:45 p.m.: SID/DSCC Business Conference, How Merck KGaA, Darmstadt, Germany, Is Improving Display Performance // Mark Verrall, SVP R&D, Display Materials, Darmstadt
- Wednesday, May 24, 2017, 9:00-9:20 a.m.: Symposium, Session 25: Quantum-Dot and Micro-LED Displays (Emissive Displays), 25.1: Invited Paper: Improvement of Viewing Angle and Color Gamut of TN-LCDs Using Ink-Jet-Printed Quantum-Rod Color Pixel Converter // Masaki Hasegawa, Performance Materials, Japan

- Thursday, May 25, 2017, 10:40-11:00 a.m.: Symposium, Session 52: Automotive Visual Performance (Automotive/Vehicle Displays), 52.1: Invited Paper: Driving Forces: How the Mobility of Tomorrow Influences Technologies of Today // Luc Yao, Display Materials, Darmstadt
- Thursday, May 25, 2017, 10:40-11:00 a.m.: Symposium, Session 53: LCD Materials (Liquid-Crystal Technology / Display Materials and Processes); 53.1: Invited Paper: Coatable Optical Films for Advanced Displays // Eduardo Beltran-Gracia, Merck [KGaA, Darmstadt, Germany] Chemicals, Southampton, Great Britain
- Thursday, May 25, 2017, 1:30-1:50 p.m.: Symposium, Session 57: OLED Materials III (OLEDs); 57.1: Invited Paper: Ink-Jet Printed OLED Displays // Edgar Boehm, OLED R&D, Advanced Technologies, Darmstadt
- Friday, May 26, 2017, 10:40-11:00 a.m.: Symposium, Session 79: New LCDs II (Liquid-Crystal Technology); 79.1: Invited Paper: New Liquid Crystals for Light-Guiding Application: From Automotive Headlights to Adaptive Indoor Lighting // Owain Parri, Display Materials, Darmstadt

All events will take place at the Los Angeles Convention Center. Visitors to SID Display Week 2017 (May 21 – 26, 2017) can find Merck KGaA, Darmstadt, Germany, at stand 629.

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Merck KGaA, Darmstadt, Germany, is a leading science and technology company in healthcare, life science and performance materials. Around 50,000 employees work to further develop technologies that improve and enhance life – from biopharmaceutical therapies to treat cancer or multiple sclerosis, cutting-edge systems for scientific research and production, to liquid crystals for smartphones and LCD televisions. In 2016, Merck KGaA, Darmstadt, Germany, generated sales of € 15.0 billion in 66 countries. Founded in 1668, Merck KGaA, Darmstadt, Germany, is the world's oldest pharmaceutical and chemical company. The founding family remains the majority owner of the publicly listed corporate group. Merck KGaA, Darmstadt, Germany, holds the global rights to the „Merck“ name and brand. The only exceptions are the United States and Canada, where the company operates as EMD Serono, MilliporeSigma and EMD Performance Materials.