

Press release

June 16, 2016

Flexible OLED applications arrive

R2D2, a joint project to analyze and development high-TRL processes and technologies for manufacture of flexible OLEDs funded by the German Federal Ministry of Education and Research (BMBF) has been successfully completed.

In contrast to point sources like LEDs made of inorganic semiconductor crystals, organic light-emitting diodes (or OLEDs) are light-emitting surfaces. Their light attains a new level of homogeneity and can be dimmed smoothly instead of in steps. The light does not throw harsh shadows and requires no reflectors, light pipes, or similar optics. This makes OLED lighting material efficient and light-weight, and additionally requires practically no supplemental cooling. OLEDs can be applied to flexible and bendable substrates and arbitrarily shaped, so they open up an entirely new world of design.

The previous high fabrication costs for OLED lighting modules needed to be reduced for the technology to be reasonably priced and easily employed for manufacturing marketable products. The processes and market sectors were thoroughly analyzed in the project now concluded, and the potential for improvement was identified and realized. A series of very practical OLED lighting applications were developed during this process that combine special design features of delicacy and flexibility with efficient fabrication techniques.

The tail light displayed at CES 2016 in January was developed as part of the project in cooperation with AUDI AG, OSRAM OLED and HELLA. It was fabricated as a complete 3D OLED module from just a single flexible OLED formed by bending it around various axes into a three-dimensional unit. AUDI AG took over specification and control of the segmented OLED and developed the interface technology, which was realized by OSRAM OLED and assembled by HELLA to fit a mounting socket design in the tail-light assembly. Two of these modules were integrated into each tail light; the emission color and brightness correspond to the ECE standard. The light emitting 3D unit requires no additional optics or reflectors whatsoever to be seen easily from all viewing angles. The 3D OLED increases safety and offers new potential for automotive design, and for development of lighting designs with particular homogeneity of the luminous surfaces and precision construction.

Fraunhofer FEP was able to demonstrate through this project for the first time that ultra-thin flexible glass is able to be coated and processed roll-to-roll. Specific OLED components were developed using this technique for design studies such as "Glowfood" in cooperation with OSRAM OLED and the Finnish lighting manufacturer Tunto Design, for example. This design, as well as an additional one, was created by taliaYstudio in Vienna under contract from OSRAM.

Dr. Christian May, Project Coordinator and Division Director Flexible Organic Electronics at Fraunhofer FEP, summarized: "The R2D2 Project funded by BMBF has brought OLED technology in Germany a good deal further. Flexible OLEDs in innovative lighting solutions will be coming onto the market in the near future. Other sectors will follow suit. There are already prospective designs for household appliances and even for aircraft over the long term."

AUDI AG is offering the glass-based OLED technology in a high-volume production model for the first time as the tail lights for the TT RS¹. This was already presented at CES 2016 in Las Vegas beside the Audi “e-tron quattro” concept vehicle with the tail lights developed from flexible OLEDs under the R2D2 development project. Progress in OLED technology is happening rapidly. The transition to a production-ready product has been achieved through the advances from this project.

Novaled, a leading global expert in OLED materials and technologies for high-efficiency, long-life OLEDs, was a member in the consortium. Novaled was able to optimize the OLED layers and charge-carrier transport materials to meet the high demands of the automobile industry. Cost-effective solutions were devised. This included providing materials having stable fabrication processes that can be efficiently employed in mass production, as well as methods that can ascertain the compatibility of new organic materials with manufacturing processes, thereby saving development time.

The consortium was further bolstered by VON ARDENNE GmbH, a market leader in equipment for high-productivity roll-to-roll coating of flexible substrates, who made sure the technologies developed could be implemented industrially.



A 3D OLED tail light module with three independently controllable segments made from a single flexible OLED was developed under the R2D2 project based on designs of AUDI AG in cooperation with OSRAM and HELLA. Two such modules are mounted in a complete tail light assembly.

The future on view: tail lights of flexible OLEDs – presented by Audi at CES 2016 in Las Vegas with two of the OLED modules developed under the R2D2 project.



“Coolfood” OLED demonstrator from DIEHL using an OLED module fabricated by Fraunhofer FEP on flexible ultra-thin glass.



“Glowfood” demonstrator – flexible OLED tile from Fraunhofer FEP embedded in laminated wood. Coordinated by OSRAM OLED, designed by taliaYstudio, and realized by Tunto Design.

About R2D2:

The project consortium covers the entire value-added chain, from material research to equipment construction, component technology, and application studies for future products. The work planned was based on the globally recognized results of the R2Flex, So-Light, and

TOPAS2012 projects for organic electronics (in particular organic LEDs and organic photovoltaics) funded by the German Federal Ministry of Education and Research (BMBF). The direct participation of noted OLED light manufacturer OSRAM OLED GmbH and light-source end users AUDI AG, HELLA KGaA Hueck & Co, and the Diehl Stiftung & Co. KG promoted rapid and comprehensive commercialization of the research results that has an impact on the entire value-added chain through new opportunities for market penetration. R2D2 has helped organic LEDs for illumination applications attain higher awareness among the public and led to technological progress that represents an important competitive economic advantage for German companies.

The consortium partners are: Fraunhofer FEP (head of the consortium), AUDI AG, Diehl Aerospace GmbH, HELLA KGaA Hueck & Co, Novaled GmbH, OSRAM OLED GmbH, and VON ARDENNE GmbH.

The consortium would like to thank the German Federal Ministry of Education and Research (BMBF) for funding the project "R2D2" with a grant of 5.9 mill. Euros over a 30-month period.

About Fraunhofer FEP:

The Fraunhofer Institute for Organic Electronics, Electron Beam and Plasma Technology FEP works innovatively on problems in the areas of vacuum coating, processing and treatment of surfaces using electrons and plasmas, and organic semiconductors. The foundation of this work is core expertise in electron beam technology, high-rate coating using sputtering, plasma-activated as well as PECVD techniques, and technologies for organic electronics as well as for IC & systems design. Fraunhofer FEP offers a broad spectrum of research and development together with pilot fabrication, in particular for treatment, sterilization, etching, and plating of surfaces as well as for OLED micro displays, organic and inorganic sensors, optical filters, and flexible OLED illumination. Our goal is to develop potential innovations in electron-beam & plasma engineering and organic electronics to create novel and practical production processes and components for our customers.

Press contact:

Fraunhofer FEP
Ines Schedwill
Head of Marketing
Maria-Reiche-Str. 2
01109 Dresden

Tel.: +49 (0) 351/8823-238
Fax: +49 (0) 351/8823-394
e-mail: Ines.Schedwill@fep.fraunhofer.de

About HELLA:

HELLA is an independent, global, family-owned company with about 32,000 employees at over 100 locations in more than 35 countries. The company specializes in innovative lighting systems and vehicle electronics. As a technological leader for more than 100 years, it is an important partner in the automobile industry and aftermarket. In addition, HELLA develops, fabricates, and markets products in the special applications segment for specialized vehicles and for applications that are entirely independent of vehicles, such as industrial and street lighting. Moreover, HELLA collaborates with industrial partners, such as in joint ventures, bolstering its corporate profile through this proven networking strategy. More than 6000 staff members are active in research and development worldwide. Continuous high investments maintain and extend its technological leadership. Moreover, with sales of approximately 5.8 billion Euros in the 2014/2015 fiscal year, HELLA is among the top 40 automobile suppliers worldwide.

About OSRAM:

OSRAM, with headquarters in Munich, Germany, is a leading lighting manufacturer worldwide, with a history of more than 100 years. Its portfolio extends from high-tech applications based on semiconductor technologies like infrared and lasers, to intelligent networked illumination solutions in buildings and cities. OSRAM employed 33,000 worldwide at the end of the 2015 fiscal year (September 30) and achieved total sales of just under 5.6 billion Euros. The company is listed on the Frankfurt and Munich stock exchanges under commercial paper identifier LED 400, and stock market symbol OSR. You can find further information in the Internet under www.osram.de.

Press contact:

Nadine Schian
Tel. +49 89 6213-3769
n.schian@osram.com

About AUDI AG:

The Audi group, with its Audi, Ducati, and Lamborghini brands, is one of the most successful manufacturers of premium automobiles and motorcycles. It is present in more than 100 markets worldwide and manufactures at 16 locations in twelve countries. Production of the Audi Q5 begins at San José Chiapa, Mexico, in the second half of 2016. The wholly-owned subsidiary companies of AUDI AG include quattro GmbH (Neckarsulm, Germany), Automobili Lamborghini S.p.A. Sant'Agata Bolognese, Italy), and Ducati Motor Holding S.p.A. (Bologna, Italy).

The Audi group delivered about 1.8 million Audi-brand automobiles, as well as 3,245 Lamborghini-brand sports cars and about 54,800 Ducati-brand motorcycles to customers in 2015. AUDI AG achieved 4.8 billion Euros operating profit on sales of 58.4 billion Euros for fiscal 2015. At present, about 85,000 people work for the company worldwide, of which about 60,000 are in Germany. Audi focuses on new products and sustainable technologies for future mobility.

About Novaled GmbH

Novaled GmbH is a leader in the research, development and commercialization of technologies and materials that enhance the performance of OLEDs (organic light-emitting diodes) and other organic electronics. Novaled offers OLED product manufacturers a unique combination of proprietary technology, materials and expertise, and is currently the only company in the OLED industry licensing and selling organic conductivity doping technology and materials for use in the commercial mass production of display products. Novaled has developed strategic partnerships with key OLED innovators and producers throughout the world and, with a broad portfolio of more than 500 patents granted or pending, has a strong IP position in OLED technologies, structures and materials. Novaled is headquartered in Dresden with some 140 staff and with offices in Asia. Since end 2013 Novaled belongs to Samsung. For more information, please visit www.novaled.com.

About VON ARDENNE GmbH

VON ARDENNE develops and fabricates equipment for industrial coating of materials such as glass, wafers, metallic strips, and plastic film. Depending on the application, these layers

can be merely a nanometer to a few microns thick and lend the surfaces of these materials new operational properties. Coated materials are the foundation for products such as architectural glass, solar modules, and Smartphone displays. VON ARDENNE is a leading supplier in the field of coating installations for architectural glass and thin-film photovoltaics.

The company is working continuously on innovative technologies and applications for which extremely thin operational layers promise advantages. Currently, VON ARDENNE is pursuing topics for the future like coating technologies for organic electronics, flexible glass in R2R processes and for future generations of batteries and fuel cells.

VON ARDENNE is a family-owned company with its head office in Dresden, Germany. It employs 650 staff members and recently achieved total sales of 201 million Euros, of which 96.4 percent were exports. As a global enterprise with subsidiaries in China, Japan, Malaysia, Taiwan, and the USA, VON ARDENNE is committed to maintaining close ties to customers by offering first-class on-site service. VON ARDENNE installations are operating in over 50 countries worldwide.

Press contact:

VON ARDENNE GmbH
Ingo Bauer
Expert Communications
Plattleite 19/29, 01324 Dresden, Germany
Tel.: +49 (0) 351 / 2637-9000
E-Mail: presse@vonardenne.biz

ⁱ Audi TT RS Coupe and Audi TT RS Roadster:

The vehicles are not yet offered for sale. They do not possess type approval yet and therefore are not subject to directive 1999/94/EG.