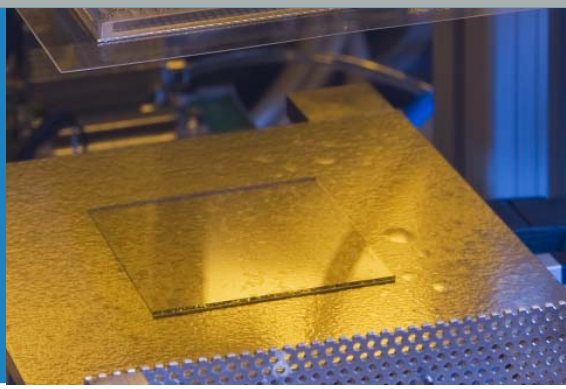
Fraunhofer
IAP



1 *Flexible polymer display with a Fraunhofer POLO ultra-barrier film*

2 *Encapsulation machine inside a Glovebox*

3 *Placing a UBF cover*

ENCAPSULATION OF OLEDs AND OPV DEVICES

TECHNOLOGY FOR THE ENCAPSULATION WITH FLEXIBLE ULTRA-BARRIER FILMS

Fraunhofer-Institut für Angewandte Polymerforschung

Wissenschaftspark Golm
Geiselbergstr. 69
14476 Potsdam

Contact:

Dr. Andreas Holländer
Telefon +49 331 568-1404
Fax +49 331 568-2504

Andreas.hollaender@iap.fraunhofer.de

www.polymer-surface.com
www.iap.fraunhofer.de

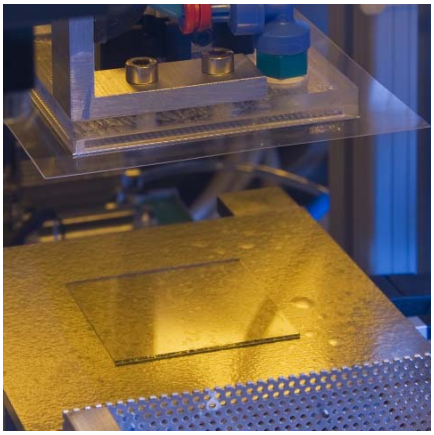
OLEDs

Organic light emitting diodes (OLED) are distinguished for example by their high energy efficiency and laminar emission of light. That makes them interesting for a number of applications as displays, signage, and lighting.
The active polymers as well as the electrode material are readily degraded by oxygen and water which results in a loss of their function. For the application these parts of a device require protection by a hermetic encapsulation.

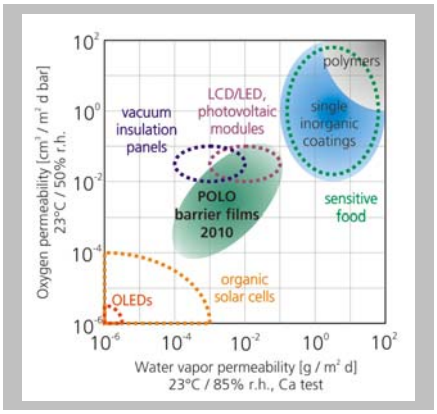
Encapsulation

For the preparation of flexible OLEDs so called ultra-barrier films (UBF) are used. These films were developed by the Fraunhofer Alliance POLO. In order to exploit the full potential of these films for high quality devices we developed a machine for the fully automatic encapsulation of OLEDs and OPVs (organic photovoltaic device). The procedure is controlled by a computer and can be programmed for various demands. The equipment is set up inside a glove box to ensure an oxygen and water free atmosphere during all the processing of the devices.

Currently, the maximum size of a device is 100 mm x 100 mm. For one OLED the cycle time accounts for about 2 minutes.
The barrier properties of substrate and cover material decide about the long term stability of an OLED device. But the quality of the joint including the adhesive and the interfaces have an influence too. The adhesive must not degrade components of the device, degas, or shrink. Moreover, flexible OLEDs require the adhesive to remain elastic even after curing. A pretreatment of the adhesive can improve its properties considerably. The thickness of the adhesive joint is supposed to be small in order to minimize the diffusion through the resin. With an optimum process we are able to prepare an adhesive layer with a thickness of less than 10 µm. For a good productivity we use UV cured adhesives.



Placing a UBF cover



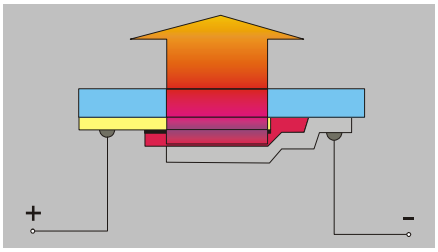
Barrier Properties for oxygen and water vapor for different materials and application areas.

The machine

The machine comprises a number of stations. The device is transported on a carriage driven by servomotors which allow a precision of about 100 µm. The devices are stored on a substrate holder in a depot. As the first step the adhesive is dosed in dots or lines onto the surface of the device. Then, the cover is placed on top and a roller laminates the cover on the substrate and distributes the adhesive homogeneously in the interface. Afterwards the adhesive is cured by an UV LED lamp. Finally, the sample holder with the completed OLED is transferred into another depot and can be removed of the glovebox.
The encapsulation process can be adjusted to the usage of substrate and cover made of an UBF, to full glass devices, and to glass-UBF devices.

Flexible OLED test device

Displays on flexible ultra-barrier substrates have been manufactured with different layouts. Ultra-barrier films were provided with Indium-Tin-Oxide (ITO) transparent electrodes. Different polymer emitting polymers in red, green, blue and white were used for the assembly of flexible OLEDs. The electron injecting electrode was prepared by evaporation of calcium and silver on top of the device. For the encapsulation, a second flexible ultra-barrier film was laminated on the OLED structure. The application of a voltage in the range between 3 and 10 V to the device results in an electroluminescence of a brightness up to of 1000 cd/m².
The light emission of the device is preserved even after storage under ambient atmosphere for several months.



Flexible OLED device structure