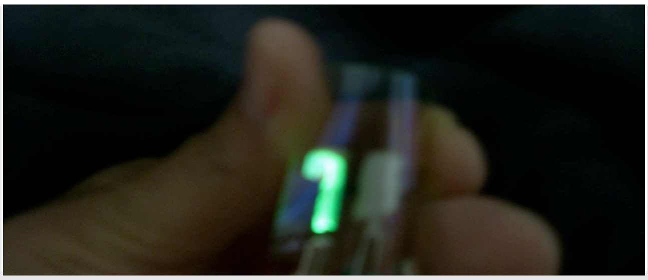
A new ultralow-cost, lightweight and flexible display technology, based on organic light emitting diodes (OLEDs) is emerging. OLEDs are thin film devices which use electroluminescent organic materials. The advantages of organic materials derive from the easiness of chemical manipulation to tune the colours and to obtain low-cost processability such as inkjet printing on plastic substrates.



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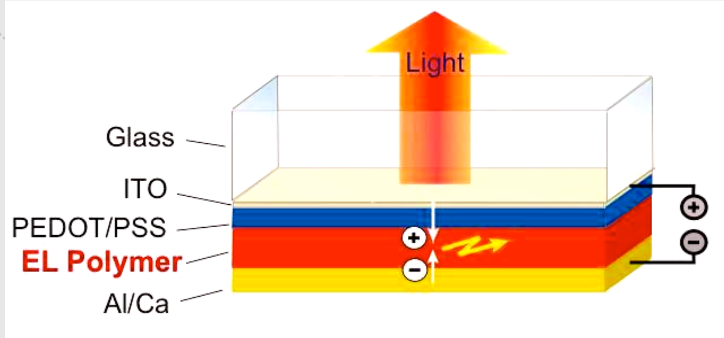
Organic Light Emitting Diodes (OLEDs)

Organic light emitting diodes (OLEDs) are electronic devices made by placing a thin film of an electroluminescent organic material between two conductors of different work functions. When an electrical voltage is applied, electrons and holes are injected into the electroluminescent material. When these recombine, light is emitted. Additional thin film layers are usually added for different purposes such as electron and hole transport.

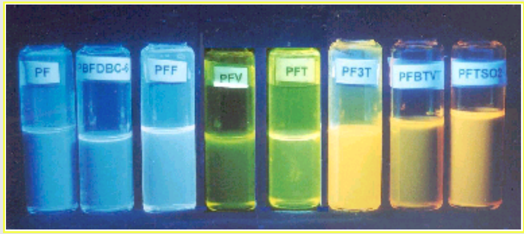
OLEDs can be used for large and small area flat panel flexible self-luminous displays in many consumer products.

Some of the advantages of OLED technology rely on the easiness of chemically modifying the materials, either to tune the colours or to make them processable, through the control of solubility.

We have been involved in this research area for several years, either designing and synthesising new materials, or engineering the electrode-polymer interfaces, by inserting appropriate monomolecular layers, in order to improve the luminescence efficiency. New materials have been developed with controlled emission colour (for multicolour displays), controlled charge injection, controlled solubility, and controlled interchain interactions for optimisation of luminescence efficiency.



An organic light emitting diode (OLED) is based on two electrodes of different work functions such as Ca, and Indium tin oxide, (ITO), separated by an electroluminescent (EL) polymer, which emits light when electrons and holes are injected from the electrodes. In this case, a layer of a hole conducting polymer (PEDOT/PSS) is added.



The emitting colour is controlled through chemical modification of the molecular structure. Engineering the molecular structure can also provide solubility for easy processing as well as optimisation of luminescence efficiency

Materials

LEDs based on both low molecular, sublimed materials and on solution processable electroluminescent polymers have been studied.

In particular, we have synthesised and characterised a family of electroluminescent copolymers, derived from polyfluorene. We showed how their properties depend on their molecular structure.

Self-assembled dipolar monolayers (SAMs) to improve hole injection from ITO

SAMs formed with molecules with different dipole moments, which induce different shifts on the ITO workfunction, affect significantly device properties.

We observed that an adequate choice of the molecules forming the SAM can definitely improve the performance (such as efficiency, light-onset voltage and maximum luminance) of LEDs based on various electroluminescent polymers.

Crosslinkable polymers for multilayer LEDs

A series of photocrosslinkable polymers have been prepared. This allows the preparation of patterns at dimensions down to micro- or even submicrometer dimensions (this type of polymers is also being investigated for applications in field-effect transistors). As they become insoluble upon exposure to UV light, this allows, for instance, the fabrication of multilayer devices prepared by polymer deposition from solution without destroying the underlying layer.

In fact, we demonstrated the fabrication of multilayer LEDs, with improved efficiency, using these materials.

References:

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Further information at http://www.lx.it.pt/~alcacer/TM_Group/

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