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FLEXled

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Project Summary



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Abstract: The FLEXled project aims at demonstrating reliable flexible displays for nomadic consumer electronics applications, based on a flexible emissive technology: polymer light emitting diodes (PLED). Passive matrix displays (up to 4" 320x240 pixel RGB colour) on flexible substrates will be made. The FLEXled research project will consider all aspects crucial for a successful demonstration of the flexible display concept, including: new substrate materials; process and encapsulation for flexible colour PLED; mechanical testing and modelling; lifetime performance; and finally interconnection with driving integrated circuits. The bending radius while display functioning will be at least 4 cm (comparable to a coffee cup). Lifetime (> 10000 hrs) and screen performance will match market requirements. The FLEXled research project will pave the road for new manufacturing approaches (reel-to-reel) and new applications (e.g. e-paper, smart cards, wearable displays).

Keywords: Displays - Flexible - PLED

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FLEXible Polymer Light emitting displays

Technical:

The aim of the FLEXled project is to demonstrate high performance **flexible** displays based on polymer light emitting diode (PLED) for portable consumer electronics applications such as mobile phones and personal digital assistants (PDA.)

Humans are not made with straight lines and right angles. A more intuitive and natural interaction would naturally occur with devices that are not flat and rectangular. It is a fact that current design tends to move away from the square form factors dictated by the displays.

Today's cell phones, PDA's and hand held computers are relatively fragile mostly due their end of life due to broken glass displays.

High performance **flexible** passive matrix colour Small Graphic Display (SGD) demonstrators will be made, solving the problem of restrained shape, design freedom and fragility of today's displays.

Most flat panels displays for portable applications today are based on liquid crystal display (LCD) effects, they suffer form intrinsic shortcomings (e.g. strong viewing angle dependency, low contrast, high power consumption). Polymer light emitting diodes (PLED) on the other hand are especially suited for **flexible** applications since they offer excellent viewing angle, contrast and low power consumption. Flexible PLED are an enabling technology paving the road to new applications (electronic paper, smart cards and wearable devices) and low cost production options (reel-to-reel).

Although the future displays will not be limited in size and shape, the FLEXled project focuses on showing feasibility by demonstrating **flexible** small passive matrix displays. The target formats and performances will be based on requirements set by market information obtained by the display producer in the consortium.

This project will leverage the full potential of light-emitting polymer technology for **flexible** and free-shaped display devices. For this purpose new flexible substrate materials, packaging, test methods and processing options will be researched. The displays will be incorporated in concept systems for consumer end-use. A further objective of the project is to enhance the materials infrastructure in Europe suitable for **flexible** polymer electronic device applications. This project will benefit from ongoing research and development efforts in the PLED field. In order to exploit these efforts and avoid unnecessary overlap with ongoing European projects, this project will rely on existing and newly developed organic materials and processes. Optimised materials, including substrates, encapsulation and conducting layers suitable for manufacturing these **flexible** devices are another important objective. Moreover, novel permeation and mechanical test methods necessary for the optimisation of substrates and encapsulation layers will also be developed.



Artist's impression of the display of the future.

Objectives:

The ultimate goal of the FLEXled project is to demonstrate reliable **flexible** displays (RGB colour passive matrix) for consumer electronics applications, based on polymer light emitting diodes (PLED). The displays will be enabled by:

- New flexible substrate materials: transparent, hermetic to water/oxygen, with excellent transparent conductors
- Processing of PLED on flexible substrates, including hermetic encapsulation, yielding reliable displays (long lifetime)
- Testing of the displays (performance, lifetime); measuring, modelling and understanding substrate materials properties (e.g. permeation , mechanics) and their limits

Integration of the flexible matrix displays demonstrators with driver integrated circuits.

Description of work:

This project will demonstrate flexible displays based on polymer light emitting diodes (PLED) insuring good front of screen performance. New flexible substrates will be obtained, using new high temperature (300°C) polymer films, inorganic diffusion barriers, glass micro sheets and new conducting transparent oxides (TCO). Full colour PLED displays will be made by ink jet printing luminescent polymers on structured flexible substrates. New options for encapsulating the displays (e.g. via multi-layer hybrid layer coatings) will be explored and implemented in the display process to insure sufficient lifetime of the displays. Cutting techniques insuring the separation of flexible displays, non-square form factors and effective interconnects will be researched. Testing and modelling of devices and materials will play an important role, providing the feedback necessary to optimise substrates and display making. Basic understanding of the functionality of flexible displays and materials in view of future production techniques (reel-to-reel) will be obtained developing new mechanical tests and models for the brittle functional layers (e.g. TCOs, diffusion barriers) as well as new permeation measurement techniques. Integration of the results of the different parts of the project will result in flexible PLED displays provided with driver ICs, according to specifications based on market analysis. The end of the FLEXled project will result in flexible PLED display demonstrators, new substrates and processing options as well as characterisation methods and models.

Expected results:

The end results of the FLEXled project will be demonstrators of RGB colour flexible matrix displays. The target applications are display modules for handheld electronic consumer devices about 4" diagonal, 320x240 pixel RGB colour (PDA resolutions). The bending radius while display functioning will be at least 4 cm comparable to a coffee cup. Lifetime (> 10000 hrs) and screen performance will match market requirements.

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Start date
1 April 2002

Duration
24 months

More information on the FLEXled project can be found on its public web site

<http://www.extra.research.philips.com/euprojects/flexled>