



FLASHED! TOUCHSCREENS FOR FLEXIBLE DISPLAYS

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A newly developed material from the Fraunhofer ISC is a major step forward in the development of flexible display technology: Printable sensor materials of the kind that are being developed in Würzburg in the scope of the »FLASHED« project of the EU.

Sensors printed onto plastic films might make the films sensitive to deformation. Large-surface flexible films send signals indicating their degree of deformation directly and at high resolution to a computer to serve as a control signal. They are combined with a display such that tablet PCs or smartphones can be operated not only by means of virtual switches and buttons, but also through the deformation and motion of the film by input patterns that can be digitalized directly and displayed spatially.

This sounds the bell on a change in paradigms in how we use e-books, tablets, and other digital media. The partners of the »FLASHED« project of the EU, which commenced in October 2013, Joanneum Research, Media Interaction Lab of Hochschule FH Oberösterreich, FlexEnable, and Microsoft Research, presented the FLEX SENSE display to the general public for the first time in October 2014 to demonstrate the technology.

FLEX SENSE is a very flexible film with a touch-sensitive surface that measures any deformation by itself. This is done by quasi-transparent piezo-electrical sensors that are printed on the film and record the deformation. Combined with the development of flexible displays, this will enable future innovative input options by means of which an electronic device can be controlled much more intuitively than by buttons, switches or swiping.

Piezo-electrical printing pastes and ferro-electrical films

The team of Gerhard Domann, who is the director of the Optics and Electronics department at the Fraunhofer ISC, developed novel piezo-electrical printing pastes for this application that make a flexible polymer film sensitive. This allows for flexible assembly of electronic pressure sensors by simple printing processes. The pressure and bending sensors needed for FLEX SENSE were printed directly onto flexible film substrates.

The special advantage being that powerful sensors can be produced at lower prices, while consuming less material as compared to other previously known processes. Moreover, the printed pressure sensors can also be used as actuators and thus facilitate, e.g., haptic feedback. Combining the sensor properties with haptic feedback can improve the user-friendliness and the range of functions in many applications.

Ferro-electrical polymers are used as the basic material for the printing pastes. Due to their special molecular structure, they become oriented spontaneously. As a result, the previously needed mechanical orientation processes are dispensable and the sensors can be printed onto the substrate. These ferro-electrical printing pastes were developed by the Fraunhofer ISC in the predecessor project »3Plast-Sensors« and presently were used as the basis of the new development. Special benefit as compared to other ferro-electrical polymer pastes: The formulation from the Fraunhofer ISC does not include any toxic solvents and can be scaled-up to a large production scale without any difficulty.



Controllable temperature behavior

The sensors, which can be produced inexpensively from the ferro-electrical polymers, can record not only changes of the mechanical pressure - such as when the flexible display is being bent and moved - but temperature changes as well. Accordingly, they can also be used as proximity sensors. Even a small change of temperature, e. g. when a hand comes close to the sensor, triggers a corresponding signal. But the developers must also be able to suppress this effect when it is not needed. The temperature sensitivity of the FLEX SENSE display has already been reduced significantly in order to attain higher spatial resolution.

It is a prerequisite for the widespread use of sensors of this type that their temperature behavior can be controlled. For this purpose, piezo-electrical particles are added to the ferro-electrical printing pastes. Crucial factors for the performance of the sensors are that an extremely narrow size distribution window of the particles is maintained and that the particles can be embedded into the polymer matrix uniformly and free of agglomeration. Process know-how has been accumulated for this purpose and robust processes for particle preparation and a reliable mixing process for polymer matrix and particle dispersion has been developed.

A lead-free future

To date, the sensory properties are controlled by the addition of piezo-electrical particles made of lead-titanate. In the scope of the EU directives concerning the avoidance of materials classified as a health hazard, the use of lead in the field of microelectronics must cease in the future. It is therefore an important goal in the development of new materials to replace the lead-containing piezo-material of the sensors by other sensory materials without suffering significant losses in sensitivity. For this purpose, new ferro-electrical particle-matrix systems

are being developed and adapted to common screen-printing processes in Würzburg in the scope of the »FLASHED« project.

Flexible displays – robust, inexpensive, and versatile

The major advantage of printed flexible touch displays is their freedom in design. They can be adapted to most any surface. The display surface can be »unrolled« and thus adapted to any need. Polymer-based touch displays weigh less and are more robust than the conventional hard, glass-based touch-sensitive displays of tablets and the like. Inexpensive starting materials, avoidance of the use of critical raw materials such as lead, and the easy processing were the major requirements on which the partners of the »FLASHED« project focused in this new development. Accordingly, using the new printing pastes from the Fraunhofer ISC, a sensor can be built-up on a flexible film in just three printing steps. The results of the »FLASHED« project should contribute to the future implementation of large-sized touchscreens that are lightweight, robust, and flexible.

www.flashed-project.eu

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The outcome of the »FLASHED« project will be to give new impetus to the European display and printed sensor sectors throughout the value chain. It helps position the emerging European flexible electronics industry in the equivalent place to that currently occupied by the Asian glass-based display industry and it will create new opportunities for European companies, not in linear improvements to existing solutions but in the creation of new and innovative products.

(Press release 14 Feb. 2014)