Printed optical electronics come into view

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Imagine printing electronics directly onto organic materials. © Rolffimages - Dreamstime.com

European researchers have taken a major step towards the goal of developing printable electronics that can be used for creating radio frequency identification tags and flexible watch displays.

Researchers have long dreamed of being able to print electronic components directly onto organic materials such as paper, fabrics, or plastic.

In addition to being able to fabricate large numbers of everyday devices such as watch displays and other applications cheaply, they envision novel applications including electronic paper, eyeglasses with embedded displays, or even smart clothing.

Researchers in the EU-funded CONTACT project have demonstrated

that with suitable inks and printers, organic liquid crystal displays and other optical electronic devices can be printed out precisely.

The Technical University of Ilmenau, a CONTACT partner, has shown that within the printing process patterned glass plates can be used.

The project researchers hope to follow this proof-of-principle by developing a state-of-the-art gravure printing press, called Labratester 2. The press will be able to print hundreds of thousands of organic thin film transistor (TFT) arrays or other devices precisely and efficiently.

Labratester 2 is currently being finalised by Switzerland-based Schläefli Machines, another project partner. The company's challenge is to perfect the extremely precise machinery needed to correctly align the layers of materials needed to form arrays of organic TFTs and other circuit elements.

Obstacles overcome

Project coordinator Alan Mosley says that the most challenging problem the project team encountered was when they tried to lay down the first layer of a liquid crystal display over the TFT array they had already printed.

"What we found was that when we put down the first layer associated with the liquid crystal manufacture, it destroyed the TFT layer," he says. "You have to use aggressive solvents, which attack organic materials."

Project researchers at the Imperial College London eventually found ways to modify the inks and other materials making up the TFT layer so as to resist the solvents. The result is a process for printing a TFT layer that is compatible with a liquid crystal display.

Mosley also credits consortium partner IMEC in Belgium for research leading to the special ink formulations used to print the electronic components.

The group's next challenge is to replace their current printing platform, Labratester 1, with the more sophisticated Labratester 2. Although both presses are capable of printing the tiny structures needed for optical electronics – 25 micron features with 25 micron spacing – Labratester 2 will be able to align sequential layers with 10 micron precision.

"You want to put down one layer and then lay the next one on it in a precise position," Mosley says. "But the Labratester 1 simply wasn't equipped to do that."

He explains that Labratester 2 will use optical cameras to detect alignment marks in order to register each layer precisely over the previous one.

Wide range of expertise

CONTACT, which was funded under the EU's Sixth Framework Programme for research, drew together the expertise of leading academic and industrial partners from Belgium, Germany, Switzerland and the UK.

In addition to fabricating the printers, the researchers made advances in formulating, synthesising and testing new materials, glass technology and thin-films.

Although the 42-month long project has now ended, two of the project partners, Schläelfli and Asulab, have opted to complete and test the Labratester 2 printer. Switzerland-based Asulab, which is part of the Swatch Group, plans to use Labratester 2 to print LCD watch displays.

“There may be opportunities for some clever designs,” says Mosley. “A glass display has to be rectangular or square, but with plastic you can cut it to any shape you want.”

Mosley expects that Labratester 2 will stimulate the entire organic electronics sector.

“As far as I’m aware, it will be the most advanced bench top gravure printer available worldwide,” he says. “There’s been a lot of interest in it from laboratories and R&D groups. When you look around the world, there are a lot of people interested in organic electronics.”

The Labratester 2 will be capable of printing only moderate numbers of devices at a time, but the advances that have gone into it can be transferred to faster machines.

“What we feel is that the machine will evolve into something that could do millions of copies of a certain item per year,” says Mosley. “It has that potential.”

Source: ICT Results