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# Hot off the press

**Organic electronics holds the promise of being able to produce large-area electronic circuitry onto almost any substrate at exceptionally low cost, but technical issues related to depositing many successive layers from solvent threaten to hinder development. A new technique for depositing organic materials by thermal imaging could help overcome such issues.**

*23 January 2003*

**Ed Gerstner**

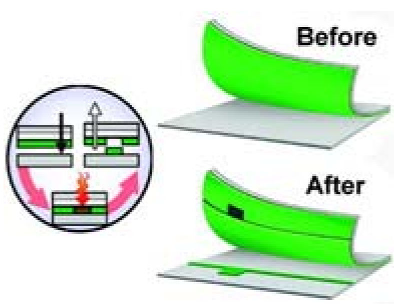
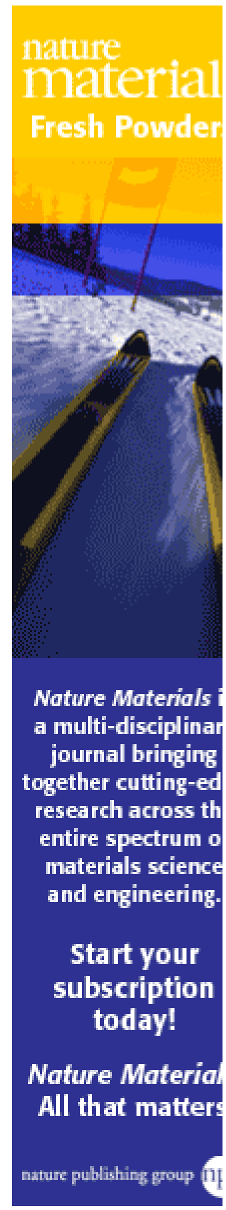



Illustration of the authors' thermal imaging transfer process. The transfer layer, which consists of the organic material to be deposited, a thin, optically absorbing metallic film, and a flexible, transparent carrier, is first placed in contact with a substrate. The desired pattern is then drawn on this layer using a focused laser beam, the localized heat from which causes the ablation and transfer of organic material to the substrate.

Conducting and semiconducting polymers offer the potential for electronic components to be fabricated over very large areas onto almost any substrate and at very little expense. Not only is this attractive for the manufacture of high-tech electronic goods such as large-screen displays, but also offers exciting possibilities for the production of disposable electronic components for applications ranging from wearable electronics to the electronic tagging of supermarket groceries. Before such possibilities become reality, however, there are still a number of technical issues to be resolved. One is the difficulty in finding chemically compatible processes for depositing and patterning multiple layers of organic material. In a new study reported in this week's issue of *Applied Physics Letters*, Graciela Blanchet



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and colleagues describe a dry thermal imaging process for depositing multiple layers of conducting polymers that could help overcome problems of chemical compatibility.

In addition to the low cost of organic electronic materials in comparison with conventional semiconductors such as silicon, another of the main advantages cited for these materials is the ability to deposit them onto a surface in liquid form from a solvent at low temperature. In principle, this offers the possibility of fabricating electronic circuitry using these materials by low-cost, high-speed processing techniques such as ink-jet or dye-transfer printing. Unfortunately, because all but the most rudimentary of electronic circuits requires the patterning of multiple organic layers, incompatibility of the solvents used to deposit subsequent layers with previously patterned layers represents a major technical problem that has hindered the commercial development of organic electronics.

To avoid such problems of chemical compatibility, Blanchet *et al.* have developed a printing process that avoids the need for solvents altogether. They achieve this by using a technique known as thermal imaging, which allows the patterned transfer of organic materials onto a substrate in their solid state. This process begins with a flexible multilayer 'donor' film, consisting of a transparent supporting base, a thin, optically absorbing metallic film on top of this base, and finally a layer of the organic material to be deposited on top of the metallic film. This donor film is then placed face down onto a surface or substrate onto which the organic material is to be transferred, and a computer-controlled laser beam is focused in a pixilated pattern through the back of this film. By heating the metallic film, the laser causes the ablation of organic material from the donor and thereby transfers it in the desired pattern to the substrate.

One drawback of thermal imaging is that it requires the use of materials that can withstand the heat generated during the transfer process without degrading. Although this rules out the use of a number of commonly used organic materials, the authors found that the organic conductor polyaniline doped with dinonyl naphthalene sulphonic acid can be thermally transferred without degradation. Using this material, combined with a mixture of single-walled carbon nanotubes to increase its conductivity further, they successfully patterned the source, drain and gate contacts of a working 50 cm $\times$ 75 cm thin-film transistor array.

Although the dielectric and semiconducting layers of the authors' array had to be deposited by more conventional means, with further development the authors expect to be able to use thermal imaging to pattern these layers also. Once achieved, this should enable it to be used for all the patterning and growth steps in the fabrication of a range of complex organic circuitry. In turn, by avoiding both the expensive lithographic steps of conventional inorganic electronics and the chemical compatibility problems of liquid-based organic processing, the authors hope their thermal imaging technique will bring organic electronics one step closer to commercial reality.

**Large area, high resolution, dry printing of conducting polymers for organic electronics**
Graciela B. Blanchet, Yueh-Lin Loo, J. A. Rogers, F. Gao & C. R. Fincher
We show here that thermal imaging, a nonlithographic technique which enables printing multiple, successive layers via a dry additive process can be used in combination with tailored printable conductors in the fabrication of organic electronic devices. This method is capable of patterning a range of organic materials at high speed over large areas with micron size resolution and excellent electrical performance avoiding the solvent compatibility issues currently faced by alternative techniques. Such a dry, potentially reel-to-reel printing method may provide a practical route to realizing the expected benefits of plastics for electronics. We illustrate the viability of thermal imaging and imageable organics conductors by printing a functioning, large area (4000 $cm^2$) active matrix backplane display circuit containing several thousand transistors.
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