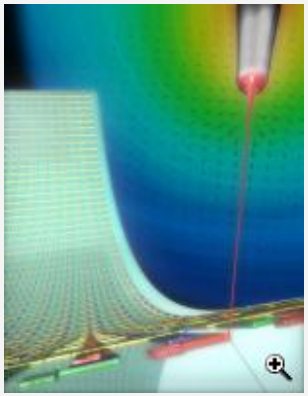
Improved e-Jet Printing

Wednesday, October 03, 2007 - Sarah Gingichashvili

Scientists at the University of Illinois have developed a technology that provides higher resolution and more versatility in e-jet printing. As opposed to conventional ink-jet printers, where heat or mechanical vibrations are used to mobilize the ink stream, e-jet printers use electric fields to pull fluids through the printing nozzles. The research team focused on nano-scale nozzles and precise control of the electric fields in order to achieve high resolution printing. The electric jet printers developed by the scientists enable low cost, simpler manufacturing of large-scale circuits, displays, photovoltaic cells and other electrical device components.



The researchers' e-jet printing head consists of a gold-coated microcapillary nozzle, only 300 nanometers in diameter. The nozzle is also coated with an organic, Teflon-like material, which helps the ink reach the targeted area smoothly. The printing patterns are produced by tiny droplets of ink, ejected onto a moving substrate. This technique allows printing lines as narrow as 700 nanometers, and dots as small as 250 nanometers.

In order to demonstrate the electronic device fabrication by e-jet printing, thin-film transistors that use aligned arrays of single-walled carbon nanotubes as their semiconductors and e-jet-printed source and drain electrodes, were printed on flexible plastic substrates. The scientists have also shown that their technology can be used with various organic and inorganic inks (including suspensions of solid objects, such as nanoscale silicon rods) to achieve resolutions at a submicron range. The e-

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jet printer can print text, drawings and images in a fully automated fashion, and the researchers are currently focusing on increasing the printing speed with large-scale nozzle arrays and on further improving the printer's level of resolution.

Electric-field induced jets of functional organic electronic inks from nanoscale nozzles forms the basis of a technique, which researchers refer to as e-jet printing, to pattern electronics on flexible substrates (Credit: University of Illinois)

“We have invented methods for an electrohydrodynamic jet (e-jet) printing that can produce patterns and functional devices that establish new resolution benchmarks for liquid printing, significantly exceeding those of established ink-jet technologies. The work represents an important milestone in the development of liquid-jet printing technology, which creates many exciting possibilities.” – said John Rogers, a leading scientist working on the project. The research team sees many possible applications for this type of e-jet technology. Large-scale circuits, displays, photovoltaic modules and related devices - all have possible applications in fields such as security, biotechnology, photonics and more. Placid Ferreira, Professor of Mechanical Science and a member of the research team, said the work opens up the possibility for low cost, high performance printed electronics. Ferreira also said that the developed technique can be applied to materials that cannot be manipulated with more common patterning methods derived from microelectronics fabrication.

Scientists from various fields of study (chemistry, mechanical engineering, electrical engineering, physics and material science) worked together on this project, within the Illinois University Center for Nanoscale Chemical Electrical Mechanical Manufacturing Systems (CEMMS). The research was funded by the National Science Foundation and was also supported by the U.S. Department of Energy.

More information on the new e-jet technology can be found on the University of Illinois website.

Further discussion of the new e-Jet technology can be found on the TFOT forums.

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