FAST MOVING FRONTS - 2010

January 2010

PDF

Ulrich S. Schubert talks with *ScienceWatch.com* and answers a few questions about this month's Fast Moving Fronts paper in the field of Engineering.

Article: Inkjet printing of polymers: State of the art and future developments
Authors: de Gans, BJ;Duineveld, PC;Schubert, US
Journal: ADVAN MATER, 16 (3): 203-213 FEB 3 2004
Addresses: Eindhoven Univ Technol, Lab Macromol Chem & Nanosci, Dutch Polymer Inst, POB 513, NL-5600 MB Eindhoven, Netherlands.
Eindhoven Univ Technol, Lab Macromol Chem & Nanosci, Dutch Polymer Inst, NL-5600 MB Eindhoven, Netherlands.
Philips Res, NL-5656 AA Eindhoven, Netherlands.

SW: Why do you think your paper is highly cited?

The paper is highly cited because the interest in inkjet printing has grown significantly over the last several years. Inkjet printing is a relatively new technique in scientific research and, in 2004, only a small number of groups explored this field for science. Currently, many groups are using inkjet printers to aid their research because:

1. Printers have become more reliable, more precise and, most importantly, cheaper

2. Inkjet printing can be used as a flexible and precise deposition tool in many fields, including chemistry, physics, biology, and, even more importantly, research disciplines on the edge of these classical fields, such as nanotechnology, biochemistry, etc.

SW: Does it describe a new discovery, methodology, or synthesis of knowledge?

The paper describes the usage of an inkjet printer for a broad field of applications. For example, the manufacturing of multicolor polymer light-emitting diodes (PLED), polymer electronics, three-dimensional printing, and also controlled drug release. These fields that had been mentioned in 2004 have also emerged in the past five years. Therefore, the topic is still "hot" as can be seen in recently published results from our group: a review on

inkjet printing of bio-materials (*Soft Matter* 5: 4866-77, 2009) and new results on the usage of inkjet printing for flexible electronics applications (*Adv. Mater*. 21: 4830-34, 2009).

Furthermore, inkjet printing can be used as a rapid materials screening tool (*Soft Matter* 4: 703-13, 2008). By printing a polymer solution, one can study, for example, the photoluminescence properties of the resulting printed films, while only using tiny amounts of the (synthesized) polymer. In this way, a polymer selection for photovoltaic devices, such as solar cells, could be done in a much more efficient manner by reducing waste and enhancing the number of characterized samples in time. In a traditional way, polymers would be tested one by one, which also takes more time.

"Inkjet printing has the benefit of being flexible—one can rapidly change the image that will be printed without making a new mask."

SW: Would you summarize the significance of your paper in layman's terms?

Inkjet printing is a technique where tiny amounts of droplets are dispensed from a nozzle. The fluid is referred to as the "ink" and usually consists of a liquid carrier and solute materials, for example small pigments when having a colored ink. Instead of printing pigments, inkjet printing has more and more been used to dispense complex fluids, for example, conductive nanoparticles to make very small interconnects on a circuit board. Moreover, biomaterials can be easily printed, since they are all water-based and later used, e.g., for biosensors.

SW: How did you become involved in this research and were any particular problems encountered along the way?

The limits of inkjet printing lie in the fluid characteristics of the ink. The ink must have certain rheological properties in order to be printable: the viscosity should be low enough, and the size of particles present in the ink should be sufficiently smaller than the nozzle aperture.

SW: Where do you see your research leading in the future?

One field that is currently emerging is the field of inkjet printed biomaterials. Various proteins, as well as DNA, can be printed and thereby open new routes to functional bio-sensors. Secondly, inkjet printing of microelectronic devices is an important field, since the technique is flexible and dispenses materials only on demand. Finally, inkjet printing shows a great benefit from being used in the field of materials screening: a direct approach to study materials in a waste-efficient and cost-effective manner.

SW: Do you foresee any social or political implications for your research?

Inkjet printing has the benefit of being flexible—one can rapidly change the image that will be printed without making a new mask. Therefore, customized devices, tailored for each customer, can become possible.

Furthermore, printed electronics will drive newspapers toward being produced on foldable, flexible displays, and each morning being uploaded to the device. People will learn to live in a world that is less based on paper and more on an efficient way of handling the global consumption of energy and fossil fuels.

Prof. Dr. Ulrich S. Schubert
Laboratory of Organic and Macromolecular Chemistry
Friedrich-Schiller-Universität Jena & Dutch Polymer Institute

Jena, Germany

And

Laboratory of Macromolecular Chemistry and Nanoscience

Eindhoven University of Technology & Dutch Polymer Institute

Eindhoven, The Netherlands

Web | Web | Web

KEYWORDS: LIGHT-EMITTING DEVICES; TRANSISTOR-CIRCUITS; 3-DIMENSIONAL PRINTING(TM); CERAMIC SUSPENSIONS; DROPLET DEPOSITION; JET; FABRICATION; TECHNOLOGY; SURFACE; FLUID.

Additional information:

Ulrich S. Schubert: New Hot Paper comment, January 2009

PDF