Organic Electronics and Sensorics

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Abstract

After more than 25 years of intense academic and industrial research worldwide, the class of organic Materials, conjugated polymers and organic molecular systems, have reached a very high level of interesting materials properties and the potential for different industrial application is now emerging. The quality and the chemical purity of these new semiconducting materials have been improved dramatically over the last 10 years by different techniques and some are now comparable with their inorganic counterparts. These organic materials are the basis of organic electronics, optoelectronics and sensorics. Resistors, capacitors, diodes, photodiodes, light-emitting diodes, field-effect transistors and optically pumped solid-state lasers can be fabricated by different methods and integrated into electronic and optoelectronic circuits. Processability and the availability of a variety of structuring techniques, which preserve the materials properties are keys for the industrial application. Organic materials and organic electronics have a number of advantages: light-weight, flexible, low-temperature processes and compatible with a variety of substrates (plastic, paper, textiles).To taylor the function and tune the parameters of certain organic electronic components one can use novel and cost efficient structuring techniques like self-assembly, soft-lithography, nanoimprint-lithography and variations (and combinations) thereof - together with conventional mask-processes. Surface engineering and controlled growth are key strategies for reproducible layer fabrication in organic devices. 3D-mulitphoton structuring allows the free structuring of materials and tools. In this paper we give an insight into different nanotechnological processes and structuring techniques for the realization of organic electronic and optoelectronic devices.

High performance organic thin film transistors (OTFTs), the prerequisite for a technology of integrated organic electronics and integrated sensorics, can be achieved only by carefully controlling all relevant device parameters during fabrication, which are the morphology of the organic semiconductor, the thickness, density, dielectric constant and surface conditions of the organic gate dielectric and last but not least the resistance to the source and drain contacts. We have produced a large body of pentacene OTFTs by varying the gate dielectric material, forcing the thickness of the dielectric layer to values below 100nm and by reducing the contact resistance by different surface conditionings. In addition, we have quantitatively studied the growth process of pentacene on different dielectrics for different temperature regimes and by varying the surface conditions of the dielectric layer. It turned out, that high-mobility pentacene OTFTs (μ>0.1 cm2/Vs) can be produced with operation voltages well below 5V by minimizing the dielectric film thickness, the contact resistance and optimizing the pentacene morphology. The miniaturization of the critical dimensions of our OTFT structures was achieved by applying special nanolithography techniques.

CV of Günther Leising

Univ. Prof. Dipl.-Ing. Dr. Günther Leising, born November, 11th, 1952 in Gleisdorf (Austria). Technical Physics study at the Technical University Graz (Austria). PhD and habilitation in Solid State Physics. Several visiting professorships and research stays like in Nantes (France), Paderborn (Germany), Cambridge (UK), Santa Barbara (USA). Research and teaching activities on photophysics, nanotechnology and the physics and chemistry of organic solids. Fritz Kohlrausch Award 1988 for outstanding research; Viktor Kaplan medal 2002 for a segment of patents. Since 1995 Univ. Prof. at the Institute for Solid State Physics (TU Graz). Author of over 500 scientific publications; 13 patents. Founder of the White-LED technology and manufacturing in Austria in 1997. Founder and director of the Institute of Nanostructured Materials and Photonics, Joanneum Research. 2000 until 2005 Senior Vice President Technology of AT&S (Austria, China, India). Married to his wife Denise for now 31 years.