Plastic Electronics - PE2014

T. Le Seguillon
CEO
Heliatek GmbH, Dresden, Germany

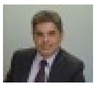
Biography
Based in Dresden, Germany, Thibaud Le Séguillon is CEO of Heliatek Gmbh, a high-technology start-up in organic solar film. Heliatek is a global leader in OPV technology utilizing nano molecules. The light-weight, flexible and possibly semi-transparent next generation solar films provide clean solar energy wherever it's needed.

Mr. Le Séguillon was previously based in Shanghai, China, where he was the President of Parlex Corporation, a 1500-employee, $100MM worldwide leader in flexible interconnect that is part of the Johnson Electric Group. The company had engineering centers in the US and Europe, 2 manufacturing sites in the US, and a manufacturing site in China and in the UK. Previously, Mr. Le Séguillon was Vice President of a Business Unit of Parlex.

Prior to working in China, Mr. Le Séguillon worked in Boston, MA, for Parlex Corporation (NASDAQ: PRLX) as Vice President of Operations with factories in the US and Mexico.

Earlier in his career, Mr. Le Séguillon was General Manager at Axon' Cable Inc., a subsidiary of Axon' Cable SA, based in Chicago, IL.

Mr. Le Séguillon is Conseiller du Commerce Exterieur de la France. He holds an MBA in International Business from Neoma Business School and a Master of Science in Engineering from ESEO.



L.G. Occhipinti
National Outreach Manager
Univ. of Cambridge / EPSRC Centre for Innovative Manufacturing in Large-Area Electronics, Cambridge, United Kingdom

Biography
Dr. Luigi G. Occhipinti is National Outreach Manager of the EPSRC Center of Innovative Manufacturing for Large Area Electronics, a partnership between the University of Cambridge, the Centre for Plastic Electronics at Imperial College, the Welsh Centre for Printing and Coating at Swansea University and the Organic Materials Innovation Centre at the University of Manchester, created to work with industry to address key research challenges for manufacturing large-area electronic systems, and Business Development Manager of the Cambridge Innovation and Knowledge Centre (CIKC).
He has more than 19 years of experience driving research and innovation in the semiconductor industry, pioneering the field of post-silicon technologies, including development and applications of: organic and printed electronics, MEMS and bio-MEMS devices, graphene-based flexible electronics, smart systems heterogeneous integration, chemical and bio-sensors for personalized diagnostics and therapeutics.

Prior to that he was R&D Programs Director and Senior Group Manager at STMicroelectronics, a global semiconductor company, leading research teams and new business development based on Heterogeneous Integrated Smart Systems, Flexible and Disposable Electronics and New Sensors technologies. During the career in Industry he developed unique achievements and success stories in terms of new business creation with strategic customers (incl. some of the top 100 global brands), new product concepts, and state of the art technology platforms (e.g. for flexible and disposable electronics, personalized diagnostics, IVD).
He has authored and co-authored over 80 scientific publications and 35 patents. Since 2004 he has been member of IEEE standardization committees P1620 and P1620.1, dedicated to organic electronics devices and circuits, and, of IEC-CEI standardization Technical Committees, TC 105, 111 and 113.

How can design thinking type approaches be effective in facilitating innovative technological development and open up new markets and opportunities?

F. Warman
Director
Soda Ltd, London, United Kingdom

Abstract
Abstract:
Fiddian will demonstrate some of the creative digital and mechatronic works he has produced over his last 18 years with Soda including science communication works, consultancy to industry, academia and government as well as social innovation projects. He will focus on a few case studies that serve to illustrate how he feels creative approaches, and design thinking in particular, can be transformative in the development and delivery of technological projects.

He will also discuss other projects, approaches and theories that are in use today and seek to propose how deep collaboration between people with an arts or design led approach and those with a more scientific or technical focus can be an effective way to drive development and open up new commercial opportunities. He will seek to define some of the attributes of design led thinking from his experience and suggest how they can be effectively applied in a wide range of projects.

CV of presenting author
Biography:

With a grounding in fine and digital arts Fiddian embodies a synthesis of creativity and technology and is passionate about the application of this hybrid in commercial, cultural, learning and social contexts.

He is skilled and experienced in identifying underlying opportunities or challenges and innovating elegant strategies and solutions to meet these needs. His eighteen years of experience leading creative teams enables efficient and effective delivery of these innovations.

Formerly a sculptor and furniture maker, Fiddian became interested in the creative possibilities of computing and mechatronics in the early 90s and completed a digital arts MA in 1996. He then cofounded SoDA (Society of Digital Artists) in 1996 to cross digital and physical making for commercial projects.

This synthesis of digital and physical still informs SoDA's practice, which encompasses creating interactive installations, objects and online experiences for a broad international range of clients from cultural organisations such as the Tate and the Science Museum, publishers such as Pearson Education and commercial clients such as Boeing. SoDA is now stepping up its development of products, principally focusing on new manifestations of the BAFTA-winning SoDAplay online simulation suite and the media montage system MASH. Interested in the rapid growth of the Maker movement and in particular the intersection of creative practice with digital and physical making, Fiddian launched Makers' Guild in 2011.

Fiddian consults to both industry and government, and has taken part in many creative research collaborations with academic and commercial partners, including Plastic Electronics research with Cambridge University and Science communication projects with a number of Universities.

Market & Technology Trends in Materials & Equipment for Printed & Flexible Electronics

E. Mounier
Senior Analyst
Yole, Villeurbanne, France

Abstract
For now, organic electronics are made on rigid substrates and mainly manufactured using vapor deposition techniques, which are costly, generally require high temperatures and generate significant product waste. Printed and flexible electronics has been a very hot topic in this past decade, holding the promise of a tremendous new market. While the printing of electronics is mainly a way to produce large electronic surfaces and reduce manufacturing costs, flexibility will provide higher robustness to the end products as well as new features, designs and shapes. The presentation will explain how this market will be addressed by players that do not necessarily come from the semiconductor field. In this emerging part of the electronics industry, chemical companies and printing equipment companies are the players that will enable volume manufacturing and will leverage technical bottlenecks. Technology enablers are therefore not those usually involved in electronics development. The solution printing & coating industry is very far from the standard electronics industry, in terms of equipment and materials and they have completely different industrial cultures. The presentation will also estimate and forecast the equipment and material markets for printed and flexible electronics. Equipment and materials markets are still low, and will remain so over the next several years. Nevertheless the start of the industry ramp up is expected in 2018 for materials. It will be driven by the OLED industry that will represent a global market of almost $ 170M in 2020 (OLED only). The equipment market will start its ramp up sooner than materials, as device manufacturers will have to prepare for upcoming volumes. Our model for equipment forecasts is based on existing and future projects in printed and flexible electronics. Today it is unclear which deposition process will be used and companies often buy cluster tools with different deposition processes inside.

CV of presenting author
Dr Eric Mounier has a PhD in microelectronics from the INPG in Grenoble. He previously worked at CEA LETI R&D lab in Grenoble, France in marketing dept. Since 1998 he is a cofounder of Yole Développement, a market research company based in France. At Yole Développement, Dr. Eric Mounier is in charge of market analysis for MEMS & Sensors, visible and IR imagers (CIS, microbolometers), semiconductors, printed electronics and photonics (e.g. Silicon photonics). He is Chief Editor of Micronews, and Yole Développement magazines: MEMS'Trends, Power Dev, iLEDS, 3D Packaging. He has contributed to more than 150 marketing & technological analysis and 60 reports. Eric is also an expert at the OMNT ("Observatoire des Micro & Nanotechnologies") for Optics.

Flexible AMOLED display driven by organic TFTs on a plastic

M. Banach
Technical Director
Plastic Logic, Cambridge, United Kingdom

Abstract
OTFTs are fundamentally the most flexible transistor technology available. Combined with recent improvements in organic materials, this offers a route to truly flexible AMOLED displays, which will transform new markets such as wearables. Plastic Logic has developed a flexible OTFT AMOLED display using low temperature processes compatible with mass manufacturing.

CV of presenting author
Mike is the Technical Director at Plastic Logic. Mike joined the company in 2003 and was instrumental in developing its flexible display technology platform and scaling the process for high volume manufacture. He now has over 15 years of experience in flexible electronics technology and is responsible for all the new innovation programs within Plastic Logic. He holds a doctorate degree in Physics from the University of Cambridge and a BA in Materials Engineering from the University of Cincinnati. He has previously worked at the Air Force Research Laboratories at Wright Patterson Air Force Base in the US and is currently the head of the UK delegation to IEC TC119, developing standards for printed electronics.

Thin-film transistors on plastic: manufacturability and applications

P. Heremans
Director
holst center, Eindhoven, Netherlands

Abstract
We will review the status of thin-film transistors on flexible plastic film, focusing on organic and oxide TFTs. Processes for organic and oxide TFTs on sheet-to-sheet are primarily developed for backplanes of active-matrix flexible displays. They should in particular be suited to drive OLEDs, as OLEDs are the frontplane technology of choice for flexible mobile displays. Their superior mechanical robustness will be a differentiator with respect to conventional silicon TFTs.
The technological maturity of these organic and oxide TFTs on plastic film has reached the point where integration of these new TFT technologies into small-scale integrated circuits is viable. By nature of the technology, thin-film ICs need mass markets to reach economy of scale. Electronic tags represent such market. Passive HF TFT tags with increasing functionality have been shown in the last years, and NFC compatible tags are a nearby target. Meanwhile, the appearance of the first thin-film UHF energy harvesters allow to envisage UHF tags in the near future. Apart from this example in the consumer market, we will also discuss applications of ultra-flexible circuits in healthcare patches.

CV of presenting author
Paul Heremans received the Ph. D. degree in Electrical Engineering from the University of Leuven, Belgium, in 1990. He then joined the opto-electronics group of imec, Leuven, Belgium to work on optical inter-chip interconnects, and on high-efficiency III-V thin-film surface-textured light-emitting diodes.
In 1998, he started the organic electronics activities at imec. In 2007, he became imec fellow and department director of the Large Area Electronics department. In 2012, he was appointed Technology Director of the Holst Center.
The main topics of Paul's research today are OLEDs, organic and oxide thin-film electronics, flexible AM-OLED displays, RFID tags, thin-film sensors and memories, and organic photovoltaics. Since 2013, he holds an advanced grant of the European Research Council. He is the author of some 10 papers at ISSCC over the last years with thin-film circuits on film.

L. Jamet
Co-Founder, Director Business Development
ISORG, Grenoble, France

CV of presenting author
Laurent Jamet is co-founder and business development director of ISORG.

He has been involved in the organic electronics industry in his previous positions of business development director for smart textiles in Sofileta (2007 - 2009) and strategic business development in CEA Grenoble (2009 - 2010) for the Printed Electronics research laboratory.

Held different positions in the semiconductor industry in STMicroelectronics (1990 - 2007) as integrated circuit design engineer, marketing manager, business development and new technology development director for consumer and industry markets (computer, automotive, wireless), in particular for Nokia.

Challenges & Opportunities for Printed Electronic and 3D-MID within Schneider Electric

C. Venet
Technology Innovation
Schneider Electric, Strategy & Innovation, Grenoble, France

Abstract
to come

CV of presenting author
Dr Cécile Venet is in charge of Large Area and Printed Electronic activities within Innovation department of Schneider Electric. She has a PhD degree in Physics & Material Science from Ecole des Mines de Paris, France (1996) and an engineering diploma in Material Physics from Institut National des Sciences Appliquées (1992). Skilled within materials forming processes and polymers rheology, she joined Schneider Electric R&D within Materials & Process department where she manages research projects for the company. She acts as industrial representative for Plastipolis French Pôle de compétitivité.

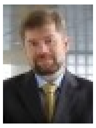
Manufacturing challenges of MEMS for wearable electronics

M. Ferrera
Technology Development Manager
STMicroelectronics, AMS, Agrate Brianza, Italy

Abstract
T B A

CV of presenting author
Marco Ferrera graduated in Electronics Engineering at Politecnico di Milano (Italy). He joined STMicroelectronics (STM) in September 1994. He has been part of the initial team that pioneered MEMS and has actively contributed to the entire MEMS history in STM. He has strong experience all over the product supply chain, from prototyping to mass production, aimed at supporting new business opportunities, products and road maps developed internally in ST and in direct collaboration with key partners and customers.

Graphene in Flexible Electronics



T. Ryhänen
Head of Business Line
Nokia, Espoo, Finland

Abstract
The combination of outstanding chemical, electrical, optical, mechanical and thermal properties of graphene makes it an interesting new material for a multitude of applications in flexible and printed electronics. The key trends and drivers in flexible electronics are discussed, and the recent progress in flexible device manufacturing is presented. The applications of graphene and 2D materials in flexible electronics summarised. A short description of the flexible electronics work in the EU Graphene Flagship is given. Nokia's work in applying 2D materials to flexible electronics is described by examples in sensor and battery technologies. Finally, the commercial and technical challenges in productising graphene technologies are discussed.

References:

(1) S.Borini, R.White, Di Wei, M. Astley, S. Haque, E. Spigone, N. Harris, J. Kivioja, and T. Ryhänen, Ultrafast Graphene Oxide Humidity Sensors, ACS Nano, 2013, 7 (12), pp 11166-11173.
(2) Di Wei et al., Ultrathin rechargeable all-solid-state batteries based on monolayer graphene, J. Mater. Chem. A 1 , 3177 (2013).
(3) Di Wei, M.R.Astley, N.Harris, R.White, T.Ryhänen, and J. Kivioja, Graphene nanoarchitecture in batteries, Nanoscale, in press.

CV of presenting author
Tapani Ryhänen is heading Nokia Technologies Business Unit's Sensor Systems Business Line that operates in Cambridge and Espoo and focuses on high added-value solutions for customers' measurement problems, based on innovative sensors, ultra-low power signal and information processing, algorithms, and wireless connectivity. Before his current role he was leading Nokia's research in sensor and material technologies, especially focusing on various applications of nanotechnologies. His is one of the creators of the Nokia Morph concept and an author and editor of a book "Nanotechnologies for Future Mobile Devices". He is a member in the Scientific Advisory Committee of the EU Graphene Flagship Project, advices the X PRIZE Foundation on its Nokia Sensing X Challenge for revolutioning digital healthcare, and is a board member of the Nokia Foundation.

What to plasticize and what not (yet) to plasticize? A general lighting application perspective

K. van der Klauw
SVP, Lighting Research Program Manager
Philips Research, Eindhoven, Netherlands

Abstract
Recent advancements in flexible plastic electronics suggest that we are at the onset of high-volume applications. Significant improvements have been made in efficacy, yield, quality and lifetime of OLED light sources and the first flexible lighting applications have been realized. But also organic electronic circuits have been demonstrated while various manufacturing technologies are being investigated.
But is this technological progress sufficient for success? In order to move from technology demonstrators to commercial breakthrough we have to consider many more success factors.
This presentation will address a number of key success factors from a general lighting application perspective, such as architectural 'separation of concerns', requirements to drive volume, killer application

identification, and moving targets in performance and cost.
Even hybrid integration has not only opportunities, but a number of challenges ahead.

CV of presenting author

Kees van der Klauw graduated from the department of Electronics Engineering of the Delft University of Technology in the Netherlands and received a Ph.D. in the area of semiconductor devices (CCD's) in 1987. He joined Philips Research where he worked several years on the design and characterization of CMOS devices and processes.
In 1992 he moved to Philips' Flat Panel Displays where he held positions in project management, engineering-, operations- and general management of Philips LCD activities and was involved in the establishment of Philips' LCD joint ventures in Japan and Korea.
In 1999, he joined Philips Consumer Electronics and became the development manager for High-End TV in Bruges, Belgium. In 2003, he became in charge of platform development for Philips Television and in 2005 became CTO of Philips Television, Monitors and Professional Display Business.
Kees joined the Philips Lighting Sector in 2009, where he was the Chief Architect and the R&D Manager for Professional Lighting Solutions. Since October 2013, he is in charge of the Research program for Philips Lighting.

Image sensors in organic and printed electronics, a disruptive technology for a new world of medical equipment, industry 4.0, connected devices and post-tactile user interfaces

L. Jamet
Co-Founder, Director Business Development
ISORG, Grenoble, France

Abstract

Organic photodetectors and large area printed image sensors give new perspectives of new product developments for the industry and consumer market mega-trends of industry 4.0 and connected devices with intuitive interfaces.
Organic image sensors offer competitive cost per area ratio compared to semiconductor technologies for large area sensing. Image sensors on plastic also give benefits of easy mechanical integration, light and robust to shock.
Product developments have been started for medical imaging and industry 4.0.
Printed optical sensors give vision to all surfaces, detecting objects, person and gestures to provide intelligence to physical objects connected to the Internet. This new generation of sensors will enable creation of new and high value services to the industry for logistics and warehouse management as first market. Other applications as process control for pharmacy are under way.
Printed optical sensors also enable new user interfaces, with robust usage with gloves, water and grease for consumer and industrial products. Integrated in display, these sensors transform display into interactive surfaces with spectacular 3D gesture recognition, for creation of new usages with the 'post-tactile' technology.
Future applications for these sensors include diagnostics, health sciences, scanning surfaces for biometrics.

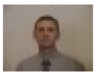
CV of presenting author

Laurent Jamet is co-founder and business development director of ISORG.

He has been involved in the organic electronics industry in his previous positions of business development director for smart textiles in Sofileta (2007 - 2009) and strategic business development in CEA Grenoble (2009 - 2010) for the Printed Electronics research laboratory.

Held different positions in the semiconductor industry in STMicroelectronics (1990 - 2007) as integrated circuit design engineer, marketing manager, business development and new technology development director for consumer and industry markets (computer, automotive, wireless), in particular for Nokia.

Flexible electronics in Intuitive Driving



S. Vanhelle
P2P3 Innovation Manager
VALEO, 74, Annemasse, France

Abstract
-Fluidity in styling , flush surface , curved surfaces (dematerialization , less complexity)
-Multi functionality, Configurability , contextualization, personalization
-Perceived quality , intuitivity from interfaces (Visual , touch, sound..) "smart" surface
-Brand image from OEMs driven with visible and touchable parts and particularly HMI perimeter
As provider of HMI solutions , Valeo is thinking to best solutions combining increasing number of functionalities and types of input/output devices (including displays) including styling trends and ergonomics approach .
In one question: How to bring more intelligence close to visible complex surfaces?
Smart surfaces are requesting new thinking in term of foil material , decoration ,lighting, sensors , displays technologies (TFT, OLED..) ,flexible circuit combination with components for architecture optimization...It's a difficult but exciting challenge!

CV of presenting author
Project Manager at G.Cartier Systems and Magneti Marelli until 1988
Innovation and RFQ Manager at Sylea (Labinal Group) for automotive switches market
In charge since 2000 to Innovation programs for Human Machine Interfaces in Automotive Industry for VALEO Switches & Smart Controls
VALEO Expert status in 2003
Branch Product Line Director and P2P3 Innovation Manager.
Expertize in touch sensitive and haptic feedback technologies as well as human factors in automotive world

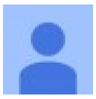
C. Rider
Director, EPSRC Centre for Innovative Manufacturing in Large-Area Electronics
Cambridge University, Electrical Engineering, Cambridge, United Kingdom

CV of presenting author
Chris Rider is the Director of the EPSRC Centre for Innovative Manufacturing in Large-Area Electronics, a partnership between 4 UK Universities with a mission to address key research challenges relating to the manufacturing of printed and plastic electronic systems. This new Centre will have a particular focus on system integration for large-area electronics systems in which component functions, such as energy harvesting and storage, printed logic circuits, printed sensors, reflective displays and printed interconnects are brought together with unpackaged silicon where necessary, for applications including smart packaging, anti-counterfeiting, intelligent sensors and smart objects.

Prior to his move to Cambridge University in 2009, Chris was a Department Head at Kodak European Research, Cambridge, leading a team of scientists working on various projects to provide technology for Kodak's Displays and Graphic Communications businesses. Within the portfolio were novel inkjet devices and inks, advanced printing plates as well as new processes for patterning active materials combining additive deposition with profiled substrates. At that time, he led R&D programmes in electronic display, solution-processed solar cells, atmospheric spatial ALD and printed transistors.

Chris is a co-founder and director of Imbrys, a high-throughput microfluidic manufacturing technology company whose devices are capable of producing monodisperse droplets of one liquid inside droplets of another. He serves on the UK's Plastic Electronics Leadership Group and the Centre for Process Innovation's Technology Advisory Committee. He is a holder of 35 patents.

Advances in Additive Manufacturing of Electronics



J. Heitzinger
President
Soligie, Inc., Savage, United States

Abstract
The attractiveness of manufacturing electronics through additive methods such as printing, coating and related methods has been the topic of many conferences over the last decade. Much of the enthusiasm is an outgrowth from the success of using these processes, and the materials developed for them, in the membrane switch and electroluminescent lighting industries. The widely adopted vision of moving beyond single component or simple passive circuits to highly complex, integrated products produced by an "all printed" approach has been pursued by many in academic, military and commercial fields. Indeed, much progress has been made in the demonstration of technologies critical for the production of electronics through additive manufacturing. These, include improvements in materials, components and devices such as transistors, memory, OLEDs, batteries and sensors as well as processing methods and equipment. Despite these advances, there remain significant gaps in capabilities to manufacture and commercialize complex electronic products using purely additive methods. As a result, a hybrid approach where circuit elements fabricated using additive means are combined with traditional electronic components is being pursued. This talk will discuss the state-of-the-art in additive manufacturing of electronics, areas for improvement and the need for taking a system level approach to product design.

CV of presenting author
John M. Heitzinger, Ph.D., President at Soligie, Inc. - Dr. Heitzinger earned B.S. degrees in physics and chemistry from the University of Wisconsin at Stevens Point and a Ph.D. in chemistry from the University of Colorado - Boulder. He is a veteran of the semiconductor industry and held positions in research and development, engineering management, customer service and product management. His efforts led to successful product launches and product penetration into new accounts at fabs in the U.S., Europe and Asia. He joined Soligie at its start in 2005, built the engineering team and led programs that defined the manufacturing processes and services that Soligie offers to its customers today. John became President of Soligie in 2011 and manages the commercial aspects of the company while continuing to drive advances in manufacturing and the establishment of partnerships with technology and component providers. John is also a member of the Technical Advisory Board for the Nano-Bio Manufacturing Consortium, an organization created to mature an integrated suite of nano-bio manufacturing technologies and transition them to industrial manufacturing.

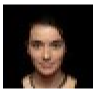
A European Horizon on Organic and Large Area Electronics

P. Reynaert
Project officer
European Commission, DG Connect Unit A1 Photonics, Brussels , Belgium

Abstract
The EU strategy for organic and large area electronics under the Horizon 2020 ICT work programme will be presented. The growth potential and importance of organic electronics for various key industrial markets and societal challenges will be explained. An overview of the projects funded will be given. Potential innovation actions for future calls will be outlined.

CV of presenting author
Philippe Reynaert graduated as a civil engineer in Microelectronics in 1978 and obtained a Ph.D. in Applied Sciences in 1983 from the Katholieke Universiteit Leuven. From 1983 to 1996 he has been in the Electronics Design Automation and was Technical Director of European Development Center in Leuven, a development group of Mentor Graphics.
In 1997, he joined the European Commission as project officer. He has been project officer in several units like Microelectronics, Embedded Systems and is now in the Photonics unit of the Directorate General Connect, where he is responsible for the research in the area of organic and large area electronics.

Printoo - a new prototyping platform for printed electronics



I. Henriques
CEO
Ynvisible, Lisbon, Portugal

Abstract
In response to early adopter demand, Ynvisible developed Printoo. Printoo is an arduino-compatible, open source, lego-like platform which allows anyone to prototype and create new interactive, connected products, using flexible, printed electronics components, including Ynvisible's displays. Printoo consists of a set of flexible boards and components that may be connected to one another to bring everyday objects to life. In a world where computers have become an integral part of our lives, Printoo aims to give people the ability to embed computational power into everyday object and devices. Printoo also enables new ways to link the physical and the digital worlds, and, because it does not require knowledge of electronic circuits, programming or soldering skills, is ideal for use by non-engineers - i.e. designers, educators, researchers. We believe that Printoo and other similar open platforms can take printed electronics beyond traditional markets and challenge the industry to explore alternative business approaches.

CV of presenting author
Inês Henriques is Ynvisible's CEO. From 2007 to 2010, Inês led and managed the research initiative at YDreams (Ynvisible's mother company) which gave way to Ynvisible. She has led the founding of the company, designed the organization of the new commercial entity and led its first financing round. Inês has a degree in Environmental Engineering from the New University of Lisbon and a PhD in Civil Engineering from Virginia Tech. She has over six years of experience working and living in the U.S. She has authored several scientific papers and patents, and received several awards for her research and academic achievements. In 2010, Inês was profiled in leading Portuguese newspaper Expresso, as one of the country's "female top talents to watch in the coming decade".

Printed Electronics: Hybrids

C.K. Lichtenberg
CEO
Roth und Rau B.V., 5605 JA Eindhoven, Netherlands

Abstract
In the next decade we recognize three major megatrends which will influence manufacturing technology and drive finally printed electronics:

- New materials for micro and nano technology
- Functional layers and structures in micro and nano format

- Reduced value chains to further downsize cost

Printed and plastic or organic electronics can fulfill a major part of these new requirements - in many cases in combination with other technologies and solutions which we call here as hybrids.

Small devices and next gen products are depending on new material developments. Conventional materials like metals, glass and plastic materials are on their limits for miniaturization and mikro shaping.

New requirements have to be fulfilled by structure, manufacturing technology, physical performance and material characteristics.

Base materials and material deposition like coatings and structuring for manufacturing of micro devices and their surfaces are the new challenges.

Some samples:
- Small sheet metals are replaced by coated and etched materials
- optical glass lenses are replaced by formed and printed organical coatings
- added with further functionality by printed piezo elements instead of focus mechanism
- control units are directly placed as bare dies (chips) on the device
- classical printed circuit boards with single functionality will be replaced with new hybrid solutions

Finally if successful these materials, technologies and miniaturization replace gigantic existing value chains with many process steps and partly different industries by lower cost, energy consumption and higher performance. These hybrid solutions combine existing technologies, new functional thin films and printed solutions.

This presentation will show more than ten samples of realized hybrid solutions in the areas of Display, OLED, OPV, Electronics, Semiconductor and printed 3D Structuring.

CV of presenting author
Claus K. Lichtenberg, Roth & Rau B.V., CEO

Started at Roth & Rau B.V. in 2009 and CEO since 2011. Claus studied at the Technical University Stuttgart Mechanical Engineering with a master certificate. Later he deepened his knowledge in Finance and Business Administration with several seminars at the Hochschule St. Gallen and Dr. Gerland in Frankfurt. Claus has more than 30 years global experience in machining and equipment industry mainly in semiconductor, electronics and precision optics. He comes with a strong background in R&D and operations for mass volume production in optics, semicon and electronics but also in midsize volume for equipment manufacturing. He has further experience with successful managed turn-around, start up and growth business. Claus fulfilled several C-level functions amongst others in stocklisted companies (Carl Zeiss, Suss Microtec AG, BE Semiconductor Industries N.V. and others).

High performance organic electronics fabricated by self-aligned lithography on large scale

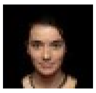
B. Stadlober
Head of department
Joanneum Research Forschungsgesellschaft mbH, Institute for Surface Technologies and Photonics, Weiz, Austria

Abstract
Miniaturization is the success strategy of the Silicon world and the enabler of today's ultrafast highly integrated electronics universe - adopting the same strategy to organic and large area electronics, fascinating with its unrivalled form factor and multifunctionality, will boost the still lagging performance of OLAE devices. For most applications in the field of internet of things, industry 4.0, lab-on-foil or food safety,

where OLAE should have a strong homebase in principle, it is absolutely necessary to increase the bandwidth and speed of organic field effect transistors (OFET) and circuits. Accordingly, aggressively decreasing the critical dimensions in OFETs is a major prerequisite for the next generation of OLAE circuits. In this presentation all aspects of downscaling the dimensions of OFETs will be discussed under the guideline of proper scaling and future-oriented solutions will be presented, ranging from patterning strategies for decreasing the channel length and interlayer electrode overlap areas by self-aligned nanoimprinting, over the usage of novel crosslinkable dielectric materials that allow reliably decreasing their layer thickness to only some tens of nanometers without corrupting the isolation strength to large-area compatible concepts for minimizing the contact resistance. By exploiting all these ideas low-voltage OFETs with remarkably high cut-off frequencies in the 10 MHz regime, as well as circuits with high gain (> 100) and large noise margin (> 80% of $V_{supply}/2$) were realized.
Finally, it will be demonstrated, how the presented self-aligned process and the novel material concepts are transferred to large-area, high throughput roll-to-roll manufacturing.

CV of presenting author
Dr. Barbara Stadlober is Head of the Research Group "Micro- & Nanostructuring" at the Institute of Surface Technologies and Photonics of the JOANNEUM RESEARCH Forschungsgesellschaft mbH (JR) located in Graz/Weiz, Austria. She has a background in low temperature and solid state physics, was part of the technology development team at Infineon Technologies Austria in Villach and joined JR in 2003 for building up the group "Organic Field Effect Transistors". Her current interests range from organic and printed electronics over R2R-nanopatterning to large-area physical sensors and biomimetic structures.

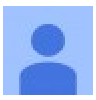
Henriques Ines



I. Henriques
CEO
Ynvisible, Lisbon, Portugal

Biography
Inês Henriques is Ynvisible's CEO. From 2007 to 2010, Inês led and managed the research initiative at YDreams (Ynvisible's mother company) which gave way to Ynvisible. She has led the founding of the company, designed the organization of the new commercial entity and led its first financing round. Inês has a degree in Environmental Engineering from the New University of Lisbon and a PhD in Civil Engineering from Virginia Tech. She has over six years of experience working and living in the U.S. She has authored several scientific papers and patents, and received several awards for her research and academic achievements. In 2010, Inês was profiled in leading Portuguese newspaper Expresso, as one of the country's "female top talents to watch in the coming decade".

Koyuncu Metin



M. Koyuncu
Senior Project Manager
Robert Bosch GmbH, Corporate Research Division, Waiblingen, Germany

Biography
Dr. Metin Koyuncu is a senior project manager at the corporate research division of Robert Bosch GmbH, Germany. He is active in the field of electronic packaging for the last 14 years. After his responsibility for development projects leading to mass production for the automotive industry, he switched to research on conformal and high density electronic packaging. During the last four years he coordinated an EC funded project "Interflex" that focused on the development of heterogeneous integration technologies for a hybrid System-in-Foil. Together with his team Mr. Koyuncu is active in the field of flexible electronic systems,

additive manufacturing for electronic packaging and molded interconnect devices. He is the author and co-author of a number of publications and patents in these fields.

Innovating in Plastic Electronics within a manufacturing model

C. Rider
Director, EPSRC Centre for Innovative Manufacturing in Large-Area Electronics
Cambridge University, Electrical Engineering, Cambridge, United Kingdom

Abstract
Innovative companies wishing to use plastic electronics in new products are faced with particular challenges in preparing to scale-up for manufacture. As plastic electronics is a relatively new technology, manufacturers often find that they are pioneers and that the challenges of securing the resources to develop high-volume manufacturing processes and optimise them for yield and cost can be significantly greater than would otherwise be the case. This talk outlines a number of these challenges and identifies ways to accelerate the scale-up process and minimise resource requirements, using examples from recent experience.

CV of presenting author
Chris Rider is the Director of the EPSRC Centre for Innovative Manufacturing in Large-Area Electronics, a partnership between 4 UK Universities with a mission to address key research challenges relating to the manufacturing of printed and plastic electronic systems. This new Centre will have a particular focus on system integration for large-area electronics systems in which component functions, such as energy harvesting and storage, printed logic circuits, printed sensors, reflective displays and printed interconnects are brought together with unpackaged silicon where necessary, for applications including smart packaging, anti-counterfeiting, intelligent sensors and smart objects.

Prior to his move to Cambridge University in 2009, Chris was a Department Head at Kodak European Research, Cambridge, leading a team of scientists working on various projects to provide technology for Kodak's Displays and Graphic Communications businesses. Within the portfolio were novel inkjet devices and inks, advanced printing plates as well as new processes for patterning active materials combining additive deposition with profiled substrates. At that time, he led R&D programmes in electronic display, solution-processed solar cells, atmospheric spatial ALD and printed transistors.

Chris is a co-founder and director of Imbrys, a high-throughput microfluidic manufacturing technology company whose devices are capable of producing monodisperse droplets of one liquid inside droplets of another. He serves on the UK's Plastic Electronics Leadership Group and the Centre for Process Innovation's Technology Advisory Committee. He is a holder of 35 patents.

From LAB to FAB, review of printing technologies for organic electronics

C. Serbutoviez
Manager Organic Electronic Division
CEA tech, Grenoble , France

Abstract
We will report on the challenges associated with the industrialization of printing process dedicated to organic electronics. The presentation will first review the basic principles of printing equipments such as off-set gravure, ,gravure printer, flexoprinter, inkjet, screen print, slot die. On a second part of this talk, we will point out the challenges with production upscaling. A specific focus will be done on the aspect of substrate

handling, ink curing and in line organic layer characterizations.

CV of presenting author
Dr. Christophe Serbutoviez (49) received his PhD in the area of organic materials for optoelectronics in 1992. He started his career Philips Research Laboratory (NL), on the development of new polymers for liquid crystal displays. He worked for 10 years at Thales Avionics LCD (Fr) as senior process engineer in the field of the industrialization silicon based active matrix. He joined CEA-LITEN in 2005, to develop activities dedicated to printed electronics. Dr Serbutoviez is currently head of the organic printed activities at CEA-Tech and he operates the CEA printing platform "PICTIC" dedicated to printing process industrialization. He has co-authored more than 30 papers and has filed 10 patents.

E. van den Kieboom
Chairman Plastic Electronics Special Interest Group
SEMI, Oisterwijk, Netherlands

Biography
Has over 25 years of hands-on management experience in launching, developing and leading both public and private technology companies. In his professional career he worked from 1986 through 1992 as a marketing and investment director for the Dutch government in attracting technology based companies from the US and the Far East. After establishing his own management consulting firm in 1992 he assisted as an outside consultant, major companies such as Philips Electronics, and Mitsubishi Electronics. Furthermore he established and/or assisted in establishing, over a period of 12 years, 7 companies in Europe in the areas of optical storage media, micro-electronics, information and communication technology. From 2002 to 2004 he assisted as an outside consultant to internationalize the scope of the Dutch Polymer Institute, a top technology institute in the Netherlands. In 2005 he founded and managed the Plastic Electronics Foundation, a worldwide technology platform for printable organic electronics, with stakeholders from both the academia, research institutes and industry. In 2012 he joined forced with the SEMI organization to become the Chairman of the Plastic Electronics Special Interest Group and to coordinate the program of the annual Plastic Electronics Conference.

The development of a manufacturing infrastructure for flexible and printed electronics

K. Rollins
Chief Innovation & Marketing Officer
DuPont Teijin Films UK Ltd, Redcar, United Kingdom

Abstract
Manufacturing flexible electronics, which is the underpinning of wearable and disposable electronics, as well as many aspects of the Internet of Things (IOTs), will require a robust supply chain. In this presentation, Dr. Keith Rollins, Chairman of FlexTech Alliance and Chief Innovation and Marketing Officer of DuPont Teijin Films, will review and explain his perspective on the development of a manufacturing infrastructure for flexible, printed electronics. Dr. Rollins will illustrate the impact of industry consortium activity on key tools and materials, as well as describe how project demonstrators foster cooperation and progress across the manufacturing ecosystem.
Successful manufacturing often proceeds from lab scale demonstration to pilot line and then volume production. FlexTech-funded R&D projects on printed batteries, sensors and scatterable media will be described by Dr. Rollins in this context. These projects highlight the pathway to integrating various flexible electronics components, which will enable smart packages, conformable displays, physiological monitors and other innovative end products.
Dr. Rollins will also present a view of the flexible, printed electronics industry from the perspective of a

substrate supplier into multiple applications. The presentation will touch upon the development of this industry over the last 15 years highlighting the focus areas over this period.

CV of presenting author

Keith Rollins is the Chief Innovation and Marketing Officer for DuPont Teijin Films, a joint venture between DuPont and Teijin Limited. He has over 30 years of experience in the chemicals industry with 25 years spent working for the DuPont and DuPont Teijin Films' polyester films businesses. Over the last few years, Dr. Rollins has focused on technology development, strategic planning and business development in the displays and flexible electronics industries. Currently, his focus is on the development and widespread use of the DuPont Teijin Films range of polyester PET and PEN materials in a wide range of applications including flexible displays and electronics applications. Dr. Rollins received his Bachelor of Technology degree with honors in Applied Chemistry in 1979 and his Doctorate in Catalysis Chemistry in 1985 from Brunel University in London, UK.

Application of Multiple Wavelength Laser Processing to the Fabrication of Flexible Electronic Circuits

J. Hillman
Manager, Advanced Materials Processing Center
Universal laser Systems, Advanced Materials Processing Center, Scottsdale, United States

Abstract

The fabrication of flexible electronic circuits presents several challenges, two of which can be addressed specifically by laser processing. One of these challenges is the selective ablation of conductive layers from the surface of a plastic substrate without damaging the polymer. The second is trimming the plastic substrate to its final shape without imparting mechanical stress, which could damage the circuit.

In this paper, we will show how the first challenge can be met using a fiber laser with a wavelength of 1.06 micro-meters. This wavelength of light is readily absorbed by conducting materials, such as silver and carbon nanotube based composites. This wavelength is also efficiently transmitted by insulating materials such as polyimide (PI) and polyethylene terephthalate (PET). This set of properties allows the 1.06 micro-meter laser beam to completely ablate the conductive layer, without damaging the substrate. We will provide a detailed technical explanation for this process, and also explore several practical applications such as circuit repair and rapid prototyping.

We shall also explore the application of a different laser wavelength to trimming the plastic substrate to its final shape following circuit fabrication. The CO_2 laser provides a laser beam wavelength that is absorbed efficiently by organic materials such as plastics. The efficient absorption of the laser energy, coupled with the collimated nature of the laser beam allows the laser to cut cut cleanly through the plastic substrate without imparting any mechanical stress to the finished circuit. This allows for cutting very closely to the active circuitry, thereby enabling smaller package sizes.

CV of presenting author

Mr. Hillman has a degree in Materials Science and Engineering from the Massachusetts Institute of Technology. He has over 20 years of experience in development of advanced fabrication processes for microelectronics, with 4 years dedicated to laser processing techniques. He has published more than 100 technical papers, and has over 50 patents in the advanced electronics field.

PrintoCent towards industrialization of Printed Intelligence

I. Kaisto
PrintoCent, Director
VTT technical research centre of Finland, Oulu, Finland

Abstract
Printocent community has been established to build capabilities in industrialisation and commercialization of Printed Intelligence. The focus in its first phase during years 2009 - 2012 was in the Pilot Factory Concept, in activation of start-up creation and in pushing forward the commercialization and industrial networking with Prinse seminars - industrial talks and stimulating demonstrator shows. The second phase 2012-2015 aims at clustering of 50 companies, utilizing, learning and developing the Pilot Factory Concept, hunting killer applications, building value chains and delivering 100 000 volume demonstrators for market trials.
Ongoing PrintoCent activities like Printed Intelligence Designer`s Handbook, design tool and component library development, roll-to-roll PrintoCent pilot factory service for manufacturing upscaling, printed component and system demonstrators, Innofest like innovation competition and active start-up creation process and European cooperation in COLAE project are shown as examples. Besides, it is very clearly seen that from regional and national point of view there has to be smart specialization to selected application areas utilizing local strengths, manufacturing services/technologies and finding complementing services/technologies by co-operations as already has been carried out in Europe by COLAE partners.
The challenge of PrintoCent community in the coming years will be concentrating regionally to the needs of fast growing start-up companies and in global perspective to the innovation and development of new type of products and services. The availability of design, development and manufacturing services provided by companies and research centres of innovation clusters will be in crucial role to make this new industry fly.

CV of presenting author
Mr. Ilkka Kaisto received his his MSc and Tech.Lic. degrees in electronics and optoelectronics engineering from the University of Oulu, Finland, in 1981 and 1987, respectively. He has been working in SME companies (Prometrics Oy, PolarporoOy, A.M.S: Accuracy Management Services Ltd) as an entrepreneur and in Insta Oy (Instrumentointi Oy, Insta Visual Solutions) in various positions from R&D management to business and quality manager to Vice President 1984 - 2005. Since then he worked in Oulu region as a regional developer in Micro- and nanotechnology clustering and started the Printocent initiative with VTT year 2008. At beginning of 2011 he started to work at VTT and currently he is Director of Printocent.

Roll-to-Roll Plasma Enhanced Chemical Vapor Deposition for Next Generation Thin Film Electronic Device & Ultra High Barrier Applications

T. Stolley
Dipl.-Ing.
Applied Materials, Alzenau, Germany

Abstract
Roll-to-Roll (R2R) production of thin film based display components combine the advantages of the use of inexpensive, lightweight & flexible substrates with high throughput production. Significant cost reduction opportunities can also be found in terms of processing tool capital cost, utilized substrate area and process gas flow when compared with batch processing systems. Nevertheless, material handling, device patterning and yield issues have limited widespread utilization of R2R manufacturing within the electronics industry. Recently, significant advances have been made in device patterning enabling the mass production of a variety of flexible electronic devices. These techniques are now so advanced that feature sizes of less than 40 nm can be produced on thin film layer stacks deposited on 50 µm thick polymeric substrates. Significant challenges also exist in terms of the deposition technologies used in R2R manufacture of these devices. Unlike traditional semiconductor or display based cluster tool platforms, R2R systems require to process substrates in a continuous fashion with rolls up to several kilometers in length. Depending upon the process itself, this imposes a limitation in terms of the mean time before cleaning (MTBC) and in some cases the

particle management strategy. This has lead to the implementation of "deposit up" or vertical winding configurations in PECVD tool designs.

Applied Materials has developed a variety of different web handling & coating technologies/platforms to enable high volume R2R manufacture of thin film silicon TFT active matrix backplanes and ultra-high barriers for organic electronics. The work presented in this paper therefore describes the principal challenges inherent in moving from lab/pilot scale manufacturing to high volume manufacturing of flexible display devices using CVD for the deposition of active semiconductor layers, gate insulators and high performance barrier/passivation layers.

CV of presenting author

Mr. Stolley is a technologist and project manager for PECVD Web Coating at Applied's Technology Center in Alzenau, Germany with 18 years of experience. He is engaged in the development and implementation program for flexible TFT backplanes for the next generation of thin film electronic devices. He was a researcher at `Fraunhofer Institute for Surface Engineering and Thin Films IST´ in Braunschweig from 1995 to 1998. He switched jobs into the industry. He joined Leybold Systems and in 2006 Applied Materials. He has worked with a wide variety of clients on start-ups of coating machines, research and development including architectural glass, display and web applications. He is skilled in project management, layer development and developing innovative solutions for coating machines.

Excellent Moisture Barrier by Plasma Enhanced Atomic Layer Deposition Aluminum Oxide for plastic electronics applications

S. Shuo Li
Senior Scientist
Beneq, Espoo, Finland

Abstract

Recently, aluminum oxide (Al2O3) by atomic layer deposition has become the most attractive material for ultra moisture barrier property for organic light-emitting diodes (OLEDs), organic photovoltaics (OPVs), and flexible displays in both scientific and industrial communities. Such plastic based electronics applications usually require low deposition temperature <100 °C,and ultra low water vapor transmission rate from 1x10e-4 to 1x10e-6 g/m2day. Plasma enhanced ALD is a promising method to deposit high quality films even at low temperatures.

In this paper, Plasma enhanced atomic layer deposition (PEALD) Al2O3 was successfully deposited on different plastic substrates at 90 °C by PEALD with Beneq TFS200 reactor. The film growth rate and refractive index were studied as a function of plasma power and plasma pulse time.With increasing the plasma pulse time from 0.5s to 6s, the film growth rate increased up to 1.6 Å/cycle and then further decrease down to 1.5 Å/cycle, which is much higher than thermal ALD process. The plasma power has significant effect on the film refractive index and film density, which is correlated with the layer barrier property. A very high refractive index n=1.64 was achieved. Such high refractive index has not been reported before by conventional thermal ALD at low deposition temperatures. The film composition was also studied by Time-of-Flight Elastic Recoil Detection Analysis (TOFERDA), which explained the plasma mechanism related film growth property.

The mositure barrier properties on plastic substrates was studied by varying the film thickness at different plasma power and pulse time. A very low water vapor transmission rate of <5e-5 at 38°C/100%RH was measured by MOCON Aquatran permeation measurement system.The barrier and passivation performance was also investigated by using Optical Ca and organic light emitting diodes.

CV of presenting author

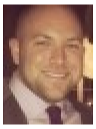
Mr. Shuo Li is currently leading the industrial process development of moisture barrier for OLED encapsulation and barrier films by plasma enhanced atomic layer deposition in Beneq OY.

Beneq is a leading supplier of production and research equipment for thin film ALD and aerosol coatings, as well as the world's premier manufacturer of thin film electroluminescent (TFEL) displays.

Beneq equipment is used for applying coatings in solar photovoltaics, flexible electronics, strengthened glass and other emerging thin film applications. Beneq has introduced several revolutionary innovations in its coating technologies, including roll-to-roll atomic layer deposition (ALD) and high-yield atmospheric aerosol coating (nAERO®).

Beneq also offers extensive coating services, ranging from experimental concept confirmation to industrial-scale production.

Commercialization Case Study: Implementation of Copper Oxide Conductive Ink with Photonic Curing for Production RFID in Integrated High-Volume Production



I. Rawson
Sr. Development Engineer
NovaCentrix, Austin, United States

Abstract
In a data-supported discussion, the speaker will present experiences and lessons learned in transitioning recent new materials and processing technologies into high-volume manufacturing. Specifically, in May at a formal launch event in Roding, Germany, RFID-equipment leader Muhlbauer debuted the world's first fully-qualified RFID production system integrating low-cost copper-oxide reduction ink and high-speed photonic curing tools. To cross the technology "valley of death", much work was done to evolve these technologies and collaboratively pass developmental hurdles. Key challenges which will be discussed included establishing batch-to-batch material consistency, achieving and repeating unit cost goals, meeting strict environmental exposure and reliability requirements, and transitioning the technology know-how to new users, with engineering teams based a continent apart. The presenter will include examples of "final mile" technology iteration, the need for which became apparent only in the integration and scale-up stages.

CV of presenting author
Ian Rawson is a senior development engineer at NovaCentrix focused on commercialization of PulseForge equipment and Metalon conductive inks. He began at NovaCentrix as a researcher focusing on RFID, display, battery, solar and lighting opportunities in printed electronics. He received a Bachelor of Science degree in Mechanical Engineer at Texas A&M university in 2008.

M. Ciesinski
CEO
FlexTech Alliance , San Jose, United States

Biography
Michael Ciesinski is president of the FlexTech Alliance (www.flextech.org), appointed in April 1995. FlexTech (formerly U.S. Display Consortium - USDC) is a R&D consortium chartered with building the infrastructure for electronic display and flexible electronics manufacturing. FlexTech sponsors and conducts a multi-million dollar technology development program, as well as providing industry technical, financial and market information events.

Since 1993, FlexTech has identified 150+projects and coordinated more than $150M in federal R&D directed to the flat panel display (FPD) and flexible electronics supply chain. Industry cost-share funds have exceeded 60% of the total FlexTech R&D program. The consortium has issued reports on a variety of topics including material handing in the FPD industry, near-to-the-eye (NTE) display products, roll-to-roll (R2R) manufacturing, and an analysis of the flexible lighting market. Most recently, FlexTech helped to create and now manages the Nano-Bio Manufacturing Consortium (www.nbmc.org).

In addition to directing an aggressive R&D program, FlexTech sponsors capital investment forums with participation from small and mid-cap companies and start-up firms. FlexTech, under Michael Ciesinski's direction, manages a creative R&D program and delivers industry expertise with value-added information on market and technology trends.
Ciesinski's prior executive positions include Semiconductor Equipment and Materials International (SEMI) and the New York State Labor-Management Committee.

Michael Ciesinski is a graduate of the State University of New York at Albany. He is a member of the Board of Directors of FlexTech Alliance and a member of Dean's Advisory Council (Engineering) at the California Polytechnic State University at San Luis Obispo.

Printed Electronics: Status, outlook and manufacturing challenges

T. Eriksson
VP Engineering Operations
Thin Film Electronics AB, Engineering, Linköping, Sweden

Abstract
Imagine a not-too-distant future in which thin, flexible sensors are affordable enough to help keep food fresh in transit, preserve vaccine efficacy on its way to the point of care, and even monitor your vital signs away from the doctor's office. In this world, a package of fresh food can tell you whether it's been mishandled in transit to the store, share nutritional information - easily and wirelessly - to a shopper's mobile device, and even alert you to a product's allergens or recalls that could harm loved ones. Once brought into your home, those same sensors can communicate directly with your refrigerator to update stock levels, recommend recipes to use expiring food to avoid waste, and trigger reorders of commonly used items. A vision on this scale requires trillions of low-cost sensors, but we can't rely on traditional semiconductor manufacturing methods to make this a reality. There simply aren't enough semiconductor wafer factories in the world to produce trillions of sensors in a cost effective manner.
The answer to this challenge is printed electronics, a field in which Thin Film Electronics is one of the world leaders. Printed electronics uses a combination of printing and coating technologies to produce electronic components such as sensors and smart labels. Using printing technologies, it will be possible to produce sensors and labels at a scale of billions or even trillions. This talk will discuss the status of the printed electronics industry and future challenges in order to manufacture devices on an ultra-high scale.

CV of presenting author
Dr Torbjörn Eriksson holds a Ph. D. in Mechanical Engineering specializing in polymer flow from the Technical University of Denmark. He has more than 10 years' experience of micro and nano technology including process development, machine design and management. Dr Eriksson spent five years at Obducat Technologies, producers of Nanoimprint Lithography machines in different leading roles. Since 2012, Dr Eriksson is VP Engineering Operations at Thin Film Electronics, one of the world leading companies that are commercializing printed electronics.

The use of elastic and thermoplastic polymer carriers for the fabrication of randomly shaped electronic circuits

J. Vanfleteren

R&D manager
IMEC & Ghent University, CMST (Centre for Microsystems Technology), Ghent, Belgium

Abstract

Today's mainstream electronic circuit manufacturing processes consists of the fabrication of a printed circuit board (PCB), followed by the assembly of packaged electronic components on the PCB using (lead free) soldering. The PCB consists in many cases of a rigid, glass fiber reinforced epoxy polymer (e.g. the FR4 material), carrying Cu interconnections, which are structured using photolithograpy and wet etching techniques. Besides rigid carriers also flexible substrates are used like e.g. polyimide. Standard manufacturing, including assembly, is done on flat substrates. After finishing the assembly flexible substrates can be deformed/bent from their flat state (as produced) to a limited number of other form factors like cylindrical or conical. However there is growing need for circuits with a random 2.5D shape. In this contribution we will present technologies for the production of such free-form circuits. In some aspects these technologies are identical to conventional circuit production : standard PCB type Cu conductors are structured, and components-off-the-shelf (COTS) are assembled using standard lead-free solder processes. The differences with standard rigid or flexible circuit production on the other hand, allowing for the random shaping, are the following : (1) the Cu conductors are structured as meanders, allowing for considerable (e.g. 60 to 100%) elongation without failure (2) instead of epoxy or polyimide, now elastic polymers like PDMS (silicone rubber) or thermoplastic materials (like PET, PC or PC/ABS) are used to serve as carriers for the electronics. This yields elastic, dynamically deformable, resp. rigid, thermoplastically deformable circuits. These carriers are applied after all necessary harsh chemical and thermal production steps (wet etching, solder assembly) are accomplished, meaning that a wide variety of polymer carrier materials can be used. The contribution will describe technologies in detail, as well as potential applications.

CV of presenting author

Prof. Dr. ir. Jan Vanfleteren received the Ph.D. degree in electronic engineering from Ghent University, Ghent, Belgium, in 1987. He is currently a senior engineer and R&D manager with the Center for Microsystems Technology (CMST) of imec, and is involved in the development of novel interconnection, assembly, and polymer microsystem technologies, especially for wearable and implantable electronics, biomedical, microfluidics, cell culturing, and tissue engineering applications. Jan Vanfleteren has a long-standing experience in coordination and cooperation in EC-funded projects. As an example he currently serves as the co-ordinator for the granted FP7-ICT-IP-"TERASEL" project on thermoplastically deformable circuits for embedded randomly shaped electronics. In 2004, he became a part-time professor with Ghent University. He is the co-author of over 200 papers in international journals and conferences. More than 130 of these publications are registered in ISI Web of Knowledge, of which more than 80 since 2008. For a complete detailed list we refer to the following Researcher-ID URL: http://www.researcherid.com/rid/D-7557-2012.
J. Vanfleteren's scientific track record is also publically available from Google Scholar :
http://scholar.google.com/citations?user=lRWgoJ4AAAAJ.
He holds 14 patents and patent applications. He is a member of IEEE, IMAPS and MRS.

HIgh Performance Flexible Electronics on Plastic for Display, Imaging and Sensing Technologies

G. Raupp
Professor and Director ASU MacroTechnology Works Initiative
Arizona State University, Chemical Engineering, Tempe, Arizona, United States

Abstract
Significant advances in flexible microelectronics over the last decade have laid the foundation for a tremendous opportunity to create new revolutionary transformational engineered products and systems with unique and desirable form, fit and function. Nano-, micro-, and macro-scale devices can be integrated on plastic sheets to produce valuable multi-functional products that are characteristically thin, lightweight, flexible, conformable, and ultra-rugged. In biomedical and health technologies, one can envision ultra-biocompatible "in-body" implantable flexible systems, "on-body" smart bandages that conform to the contours of the patient's body, or "wearable" systems for real-time unobtrusive health and human performance monitoring and user feedback. High value sensing and detection products for safety, security and surety can likewise be envisioned, from transportation systems security to structural health monitoring (SHM) for our built environment.

Before this compelling future is realized, however, major advances in manufacturable flex-compatible thin film transistor (TFT) devices must be achieved. Amorphous silicon, oxides or organic based transistors suffer from low carrier mobility and instability, and cannot achieve the high-speed, long lifetime, and robust digital and analog circuitry that would be required for the most demanding applications. Nanowire-based TFT devices offer a promising option for the required breakthrough performance due to their excellent electrical characteristics, durability, and mechanical flexibility. Mobilities well into the hundreds or even thousands are readily possible depending on material selection, enabling ultra-high performance. Recently "graphene-like" two-dimensional materials have generated significant interest and excitement. In this context the state-of-the-art will be reviewed, remaining technical challenges to be overcome will be highlighted, and possible effective development paths to be identified.

CV of presenting author
Professor Gregory B. Raupp is currently the Director of ASU's MacroTechnology Works Initiative out of the office of Knowledge Enterprise Development (OKED). His technology expertise and professional experience span many technical disciplines from engineering, materials science, manufacturing and product design to ultra-biocompatible implantable medical devices and chemistry of sustainable green processes.

Professor Raupp received his B.S with Distinction and M.S. degrees from Purdue University and his Ph.D. from the University of Wisconsin, Madison. He began his academic career with Arizona State University in 1985 where he advanced to become Professor in 1994. From 1999 - 2002 he was Associate Dean for Research in the College of Engineering and Applied Sciences, and then was promoted to Associate Vice-President for Research in 2002 (concurrent with President Michael M. Crow's coming to ASU). In these roles he was responsible for crafting and managing a diverse portfolio of interdisciplinary research initiatives, which included such unique ventures as ASU's Biodesign Institute; the Arts, Media and Engineering Program; and the Center for Conflict and Religion. While he was Associate VP he led the winning ASU proposal effort for the National Flexible Display Initiative competition, and became the Founding Director of the Flexible Display Center at Arizona State in 2004 through a US$94M, 10-year Cooperative Agreement with the U.S. Army Research Laboratory. Under his leadership, a world-class industry-government-university partnership model was created, one that enabled organizations with dramatically different missions and scales to collaborate effectively to advance science and technology on a broad front and create a portfolio of enabling commercial manufacturing technologies.

In January 2010 he accepted a dual post at City University of Hong Kong as their Vice President for Research and Technology (VPRT) and the Dean of Graduate Studies. With a redirected emphasis on large-scale collaboration, international partnerships and funding opportunities, CityU enjoyed several 20% year-on-year increases in total research funding (after three straight years of decline), including a 12x increase in funding from Mainland China, and a 10x increase from other international sources. Under his direction IP licensing deals were also ramped up significantly, with revenues at 8x the level realized over the past 4-5 years. In December 2012 he returned to ASU, but maintains an active adjunct Professor position at CityU

Thin Flexible Glass as an Enabling Material for Conformable, Flexible and Highly Integrated Electronics

D. Enicks
Manager, Thin Films Research
Corning Incorporated, Optics and Surfaces, Corning, United States

Abstract

There are important technical and economic challenges that must be addressed if conformable, flexible and highly integrated electronic devices are to be realized. However, just as the last 2 decades have witnessed a remarkable transformation in display technology, the next 2 decades may very well witness the advent and proliferation of flexible/conformable electronics. For certain, numerous barriers to industrialization must be overcome involving material development and integration, manufacturing, processing, and assembly. However, just as glass facilitated the revolution in flat panel technology, thin flexible "R2R compatible" glass is strategically positioned for the next revolution to occur. Glass is unique in that it can withstand a multitude of severe thermal, mechanical, and chemical processes while maintaining its performance enabling properties. The mechanical, chemical, and electro-optical properties of glass have been well characterized. When integrated with other materials, glass imparts a level of functionality, performance and reliability that is unachievable otherwise. This presentation will discuss thin flexible glass as a vital enabler to industrialization in this emerging segment of electronics.

CV of presenting author

Dr. Darwin Enicks currently holds the position of Manager, Thin Films Research with Corning Inc. at their Sullivan Park R&D Campus in Corning, NY Dr. Enicks leads a team of multi-disciplined scientists and engineers that focus on a broad range of thin-film related applications aimed at emerging technologies, new business development, and strategic growth. Prior to joining Corning, Dr. Enicks worked 15 years in the semiconductor industry with ATMEL Corporation where he held various engineering and management positions in Process Development and Integration, device design, Plasma and Wet Etch, Thin Film Deposition, and Ion Implant.

Dr. Enicks has published 25 papers in journals and conferences, and currently holds 35 patents and/or patents pending related to thin film transistor applications, semiconductor processes & devices, silicon germanium devices, and SOI substrate technologies. Dr. Enicks received the BS degree in Mechanical Engineering from the University of Oklahoma, and the MS and PhD degrees in Electrical Engineering from the University of Colorado at Colorado Springs where he also taught semiconductor processes and devices.

R. Gwoziecki
Head of Laboratory
Cea-Liten, Grenoble, France

Biography

Romain GWOZIECKI graduated as an Engineer in Microelectronics in 1996 and obtained a PhD degree in Physics in 1999. From 2000 to 2007, he has been working in the field of Advanced CMOS Silicon technologies with ST Microelectronics in Agrate (Italy) and Crolles (France). In 2007, he joined the Printed Component Laboratory from CEA-LITEN, being in charge of the characterization and modeling of the printed organic components from 2007 to 2013. From 2013, he is in charge of devices and process flow development for printed sensors, actuators and OTFTs circuits as head of the Printed Electrical Components Laboratory in CEA-LITEN. He held 6 patents and authored or co-authored more than 50 papers, act as reviewer for several journal (Organic Electronic and Solid-State Electronic).

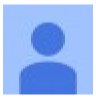
Fluorinated Electroactive Polymers for Printed Electronic

F. Domingues Dos Santos
CEO Piezotech
Arkema, Piezotech, Lyon, France

Abstract
Since the discovery of piezoelectric and pyroelectric properties of Poly Vinylidene Fluoride (PVDF), fluoride-based polymers have attracted great research interest due to their potential applications in the fields of sensors, actuators, medical imaging, IR detectors, or underwater acoustic transducers. Printable PVDF derivatives such P(VDF-TrFE) copolymers are now developed at industrial scale. These materials can be processed with the emerging printed electronic technologies, such as inkjet printing, screen printing, roll-to-roll and some other solution deposition methods to obtain ferroelectric, piezoelectric and pyroelectric devices.
Recently, thanks to the richness of fluorinated polymer chemistry, a new class of polymers has been developed: the relaxor ferroelectric polymers. These printable terpolymers are based on vinylidene fluoride (VDF), trifluoroethylene fluoride (TrFE) and a third monomer [chlorofluoroethylene (CFE) or chlorotrifluoroethylene (CTFE)] which modifies the crystalline structure from normal to relaxor ferroelectrics. These new materials exhibit large deformation and stress under applied electric field, high dielectric constant and electrocaloric properties.
Recent developments have been focussed on the association of these electroactive fluorinated polymers with other printable materials for the design of printed devices such as sensors, memories, OTFT, actuators or speakers. The combination of this new class of material with the technologies of printed and flexible electronic promises new development opportunities in applications such as smart packaging, haptic, microfluidic, integrated smart systems or large area printed sensors.

CV of presenting author
Dr Fabrice Domingues Dos Santos was born in 1970. He received the diploma of engineer of Physics and Chemistry from the ESPCI (Physic & Chemistry school of Paris). He worked in the condensed matter laboratory at the College de France where he studied wetting dynamics. He got his Phd from Pierre & Marie Curie University , Paris, in polymer Science in 1999. He joined Arkema in 2000 where he worked as a scientist and a research director until 2009. Since 2010 he is president of Piezotech (Arkema group)

Fundamentals to Start Fully R2R Gravure Printed Flexible Logic Circuits and TFT Backplane Arrays



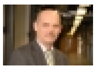
G. Cho
Professor
Sunchon National University, Printed Electronics Engineering, Sunchon, Korea, Republic Of

Abstract
R2R gravure has been considered as the most practical process for the production of costless flexible logic circuits and TFT backplane arrays, key units for the realization of ubiquitous society. As a consequence of pursuing fully R2R gravure printed logic circuits and TFT backplane arrays, this presentation will introduce fundamentals in R2R gravure systems including web handling, overlay printing registration accuracy, electronic ink formulations and printed device physics for printing flexible RFID tags and 20 x 20 TFT backplane arrays on plastic foils using a R2R gravure system.

CV of presenting author
Gyoujin Cho received the Ph. D degree from the University of Oklahoma, Norman, in 1995.
In 1996, he joined as a faculty member of the Department of Chemical Engineering, Sunchon National University, Korea, and currently he joined as a faculty member at Department of Printed Electronics Engineering, World Class University Program in Sunchon National University. Since 2002, he has focused his research on printed electronics and successfully demonstrated all gravure printed 13.56 MHz operated 4, 16, 32, and 96 bit RFID tags. Recently, he is working in developing fully R2R gravure printed TFT backplane

arrays and successfully demonstrated R2R gravure printed 20 x 20 TFT arrays with 99% yield with 60% of threshold voltage variation. Those works were introduced by BBC News Technology on Aug. 13, 2012 and NHK on Jan, 1, 2013.

Technologies and applications for thin flexible and stretchable electronics



K.-D. Lang
Director
Fraunhofer IZM, Director, Berlin, Germany

Abstract
A broad spectrum of different technologies is currently developed and investigated in order to realize wearable electronics. This comprises miniaturized flexible modules, e.g. in wrist bands and as ultrathin electronic tatoos, as well as smart textiles. All these new products need flexibility and in many cases also stretchability in order to achieve a higher level of freedom of design.
A very promising and highly manufacturable novel approach has been the implementation of conventional PCB processes for thermoplastic polyurethane (TPU) to form stretchable circuit boards (SCB). The principles for stretchable electronics were already developed in the collaborative research project "STELLA" funded by the EU. In other projects (E.g. place IT, PASTA), the materials and processes have been optimized and characterized. New areas of application, e.g. in the automotive sector, have been opened up. Different applications from medical to fashion and design have been realized to show the potential of the SCB technology. Nonetheless integration of rigid electronic components in stretchable surfaces is still difficult due to the mismatch of mechanical properties which affects the reliability, in particular at the transitions between elastic, flexible and rigid parts of the system.
To create reliable textile systems while maintaining the desired textile properties, using stretchable circuits has a great potential in addition to the use of conductive yarns. The SCB technology is suitable especially for large area applications such as textile displays and sensor arrays, which are distributed all over the body in technical textiles. It is a clear advantage for manufacturing that textile and electronics manufacturing are performed separately and the two technologies are merged at the end of the integration process. For non-textile applications the thermoplasticity of the base material can be used to create 3-dimensional electronic modules by thermoforming after planar assembly.

CV of presenting author
Prof. Lang studied Electrical Engineering from 1976 to 1981 at Humboldt University in Berlin. He received his M.S. Equivalent Diploma (Metallization Layers on GaAs) in 1981. During his employment at Humboldt University from 1981 to 1991 he worked in the research fields of microelectronic assembly, packaging and quality assurance. In 1985 and 1989 he got his two Doctor Degrees (Wire Bonding of Multilayers and Quality Assurance in Assembly Processes).
In 1991 he joined the company SLV Hannover to build up a department for microelectronic and optic components manufacturing.
In 1993 he became Section Manager for Chip Interconnections at Fraunhofer IZM (Institute for Reliability and Microintegration Berlin). From 1995 to 2000 he has been Director's personal assistant at IZM, also responsible for Marketing and Public Relations.
From 2001 to 2005 he coordinated the Branch Lab "Microsystem Engineering" in Berlin-Adlershof and from 2003 to 2005 he headed the Department "Photonic and Power System Assembly". From March 1th 2006 to March 31th 2010 he was Deputy Director of Fraunhofer IZM. Since February 1th 2011 he is Director of the institute and responsible for the chair "Nano Inter-connect Technologies" at Technical University Berlin.
Prof. Lang is member of numerous scientific boards and conference committees. Examples are the SEMI Award Committee, the Scientific Advisory Board of EURIPIDES, the Executive Board of VDE-GMM and the scientific chair of the Conference "Technologies of Printed Circuit Boards" and "SMT/HYBRID/PACKAGING". He is member of DVS, IEEE, IMAPS and he plays an active role in the international packaging community (e.g. German Chapter Chair IEEE-CPMT) as well as in the field of conference organization (e.g. Committee member SSI).
He is the author and co-author of 3 books and more than 230 publications in the field of wire bonding, microelectronic packaging, microsystems technologies, chip on board and others.

Coupled organic photodetector onto a plastic organic thin-film transistor backplane.

B. Bouthinon
PhD candidate
CEA LITEN, Grenoble, France

Abstract

We report the fabrication process and the characterization of a coupled organic photodetector arrays onto a transparent plastic organic thin film transistor (OTFT) backplane. This hybrid integrated system on foil is based on arrays of 1 diode + 1 p-type transistor. The transparency of the OTFT backplane allows us to illuminate the sensor from front and back sides depending of the addressed applications (medical imaging application and human machine interface).

The flexible hybrid sensor has a 4*4cm active area, 375µm pitch and 94x95 pixels resolution. The flexible backplane has been developed to meet the OPD requirements using Plastic Logic proprietary process by building a top Gate transistor array on a plastic substrate with p type organic semiconductor. Then, the photodiode panel was entirely printed by slot die technique. This printing technique offers the capability of a high throughput for mass production and an excellent control of the uniformity, reproducibility and thickness of the layer. The process is done at room temperature and in ambient air condition.

Main figures of merits of the hybrid photodetector are finely characterized including quantum efficiency, current-voltage characteristics, linearity over 7 decades of power light and time response measurement. Pixel characterization is also addressed. The uniformity of the pixel sensitivity is measured with a 75µm light beam diameter.

Other type of hybrid integrated system can be addressed by replacing the photodetector array by temperature sensor, memory array, actuator... Printed p type OTFT backplane is a good opportunity to monitor plenty of fully printed organic devices. The main advantages of such technology is the process compatibility between organic sensors and organic transistor arrays all printed on the same plastic substrate. This corresponds to the main roadmap of our group as OTFT, printed sensors and actuators have been developed separately in the past and can be now integrated together.

CV of presenting author

Benjamin Bouthinon is currently pursuing the PhD degree with the CEA LITEN Institute, Grenoble, France at the Printed Electronics Lab. His current research interests include the caractérization and the modeling of printed organic devices such as OTFT and organic photodetector.