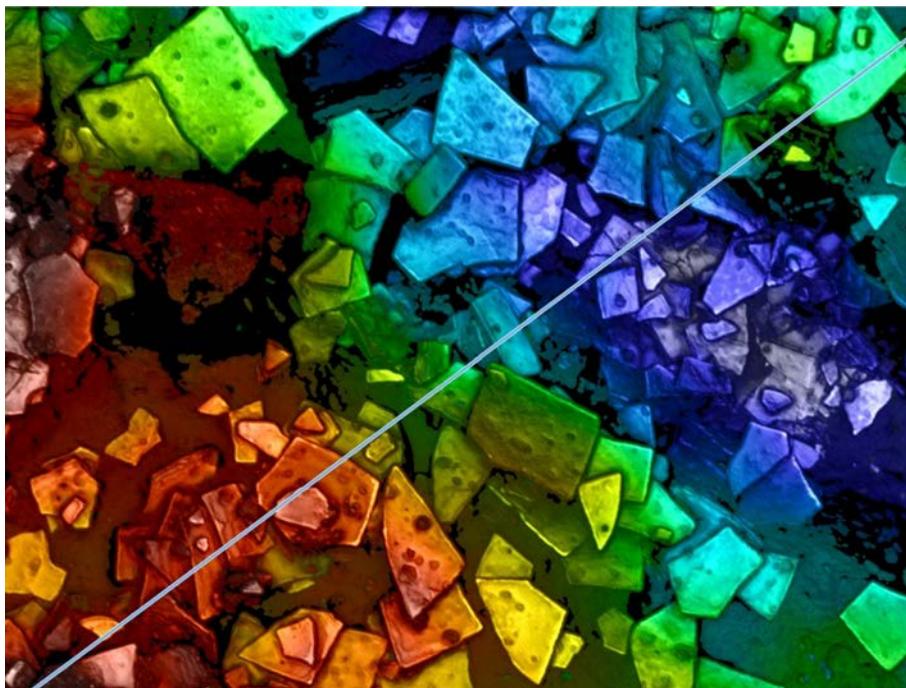

IOP | Institute of Physics

Printing and Graphics Science Group

NEWSLETTER

September 2018

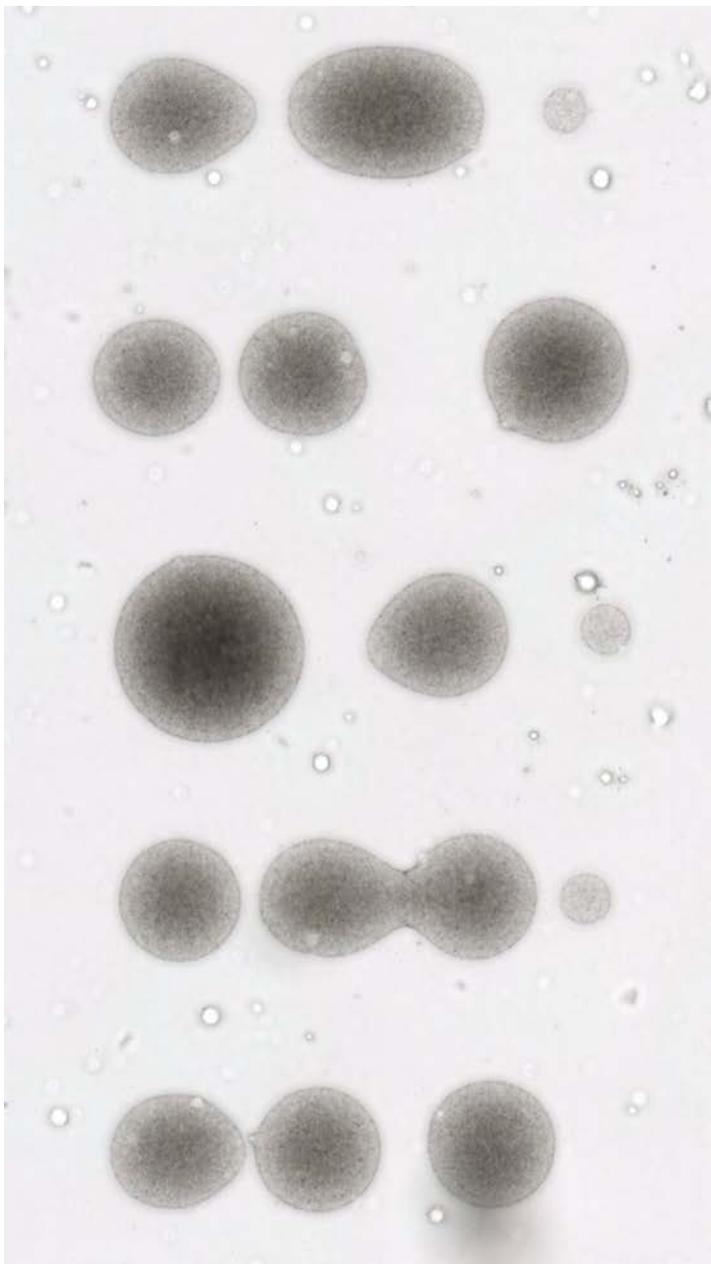
Issue no. 12



Cover image:

“Screen printed mica inks imaged using a Sensofar S Lynx 3D optical profiler by Rachel Saunders & Craig J Williams, University of Manchester”

<http://pgs.iop.org>



Martin Gouch's image of inkjet dots of different sizes. Printed using a Graphium printer and imaged with a microscope, both manufactured by FFEI Ltd.

Contents

Contents	3
Welcome and Message from the Chair	4
Reports from Recent Group Events	6
Printing for the Future 2018	6
The UK Fluids Network	8
Drop dynamics	8
Droplet and flow interactions with bio-inspired and smart surfaces	9
Clothes that reveal how you really feel	10
Market sectors for wearable electronic devices	10
Relevant areas of standardization	11
Liaison relationships for wearable electronic devices	11
Looking to the future	12
Conclusions	12
The Wide Eye – the Sign & Digital show	13
Forthcoming Group Events	16
Science of Printing and Interfacial Phenomena	16
Student Conference	16
The Science of Printing: Revealing the past and building the future	16
Other Events of Potential Interest	18
Awards	20
PGS Group Awards	20
Research Student Conference Fund	22
Optics of Liquid Crystals 2017	22
Other Information	24
PGS Group on LinkedIn, Facebook and Twitter	24

Welcome and Message from the Chair

2018 has been a fantastic year and we reflect on this in our annual edition of the PGS Group newsletter.

As a group we have hosted and participated in many events throughout the year, and we are still not finished yet! Look out for our London meeting on the Science of Printing later this year in November. A highlight for 2018 was our annual student conference, this year entitled “Printing for the Future”, where we celebrated the diversity of printing topics being explored and developed by early career scientists. Thanks to all our participants for sharing their research with us. We look forward to seeing more in a year’s time.

This year we have also welcomed a few new members to the PGS committee, with Ronan Daly joining us as a co-opted member and Gary Wells as an Ordinary member. Sadly, this year has also been one of loss as well as growth. Trevor Lambourne of Leeds University’s Colour Science Centre for Industrial Collaboration (CIC) stood down after a change of role made it impractical for him to continue on the committee. All the committee would like to thank him for the ideas and hard work he put into the PGS group over the years and wish him well in his new role. In addition, Dr Leszek Majewski’s term as treasurer finishes soon and we will be calling for a new treasurer. Leszek has done a fantastic job over the last few years and we hope he will stay with us in a different role. We will also be saying goodbye to two of our longest standing members. Dr Alan Hodgson and Roy Gray have put in a tremendous amount of work over the last 12 years and made a significant impact on the PGS group. On behalf of the committee I would like to extend my gratitude for their exceptional service, their support will be sorely missed. In particular, many thanks to Roy Gray for his continued effort in putting together this newsletter for us all to enjoy.

Look out in 2019 for more PGS events to come on our webpage <http://pgs.iop.org> or group calendar.

Emma Talbot
Chair, Printing and Graphics Science Group
September 2018

Committee Membership 2017-2018

Chair

Dr Emma Talbot

University of Cambridge

[elt43 \(at\) cam.ac.uk](mailto:elt43@cam.ac.uk)

Honorary Secretary

Mr Martin Gouch

Fellow, FFEI Ltd.

[Martingouch \(at\) hotmail.com](mailto:Martingouch@hotmail.com)

Treasurer

Dr Leszek Majewski

University of Manchester

[leszek.majewski \(at\) manchester.ac.uk](mailto:leszek.majewski@manchester.ac.uk)

Ordinary Members

Dr Feras Alkhalil

Pragmatic Printing

Dr Martyn Cherrington

Innovate UK.

Ronan Daly

Institute for Manufacturing,

University of Cambridge

Mr Roy Gray

Dr Davide Deganello

University of Swansea

Dr Alan Hodgson

Alan Hodgson Consulting Ltd.

Mr James Johnstone

Centre for Process Innovation

Mr Trevor Lambourne

University of Leeds

Dr Ehab Saleh

University of Nottingham

Dr Gary Wells

Northumbria University

Reports from Recent Group Events

Printing for the Future 2018

18 January 2018

University of Nottingham, South Building Business Scholl, Jubilee Campus.

Conference Program:

11:25 Welcome

11:30 Session 1

- Jinxin Yang, Stability of Line Structures Produced by Inkjet Printing, Manchester University
- Hui Ding, Graphene inks for 3D printing using capillary suspensions , Manchester University
- Nicholas Southon, Progress towards in-process monitoring for high speed sintering, Nottingham University
- Carlo Campanella, Processing of fluoropolymers though inkjet printing, Nottingham University
- Srimanta Barui, Novel in-situ polymerisable binder system for 3D inkjet powder printing of biomaterials: quantitative process physics and dynamics, Manchester University/Indian Institute of Science
- Thomas Cosnahan, Depositing patterns of aluminium using a vacuum roll-to-roll flexography technique, Oxford University

14:00 Session 2

- Feargus Schofield, Strong thermal effects cause anomalously long lifetimes of evaporating sessile droplets, University of Strathclyde
- Sarah-Jane Potts, Parametric study of screen printing process, Swansea University
- Fei Zheng, 3D Inkjet Printing Hydra gels: Multi-Material Printability and Feature, Manchester University
- Yaan Liu , Additive manufacture of 3D metal-polymer nanocomposites by simultaneous multiphoton polymerisation and photoreduction, Nottingham University
- Jack Hinton, Hybrid Additive Manufacturing of Precision Engineered Ceramic Components, Leeds University
- Tian Carey, Fully inkjet-printed two-dimensional material field-effect heterojunctions for wearable and textile electronics, Cambridge University
- Christopher Beach, Wearable Heart Rate Monitoring with Inkjet-Printed Graphene, Manchester University

16:00 Conference Awards

Jack Hinton and Yaan Liu were the award winners for best presentation and the abstracts of their talks are as follows.

Hybrid Additive Manufacturing of Precision Engineered Ceramic Components

J. Hinton, R. A. Harris, R. W. Kay

Future Manufacturing Processes Research Group, University of Leeds, LS2 9JT

Precision engineered ceramic components are in demand across a host of industrial sectors including healthcare, chemical, electronics, aerospace and energy. This is driven by the material performance of ceramics which provide excellent resistance to heat, corrosion, electrical and thermal insulation. Conventional methods of manufacturing such devices are reliant on tooling/template based production methods where such approaches only retain economic viability in high production volumes. Conversely, Additive Manufacturing (AM), is a family of processes that produce parts directly from a digital model without the need for templates or moulds and can rapidly produce bespoke and highly complex parts. However, inherently, each AM process alone has resolution and material constraints when processing ceramic materials which is compounded by high shrinkages and porosity caused during subsequent thermal processing steps.

Additive manufacture of 3D metal-polymer nanocomposites by simultaneous multiphoton polymerisation and photoreduction

Yaan Liu, Qin Hu, Derek Irvine, Christopher Tuck, Richard Hague and Ricky Wildman Faculty of Engineering, University of Nottingham, University Park, Nottingham NG7 2RD, UK

Abstract

Metal-polymer composites with three-dimensional structures have been fabricated using multi-photon lithography. Gold and silver nanoparticles were formed through photoreduction whilst monomers polymerised at the same time. It was found that the type of photoinitiators played an important role in the formation of gold nanoparticles. In order to increase the solubility of silver salt in organic solvent, a phase transfer method was employed that silver ions transferred from aqueous phase to toluene phase. The addition of two-photon dyes also enhanced both the geometrical uniformity and integrity of the polymerised/reduced material, enabling the first production of 3D gold-polymer and silver-polymer structures by single step multiphoton lithography.

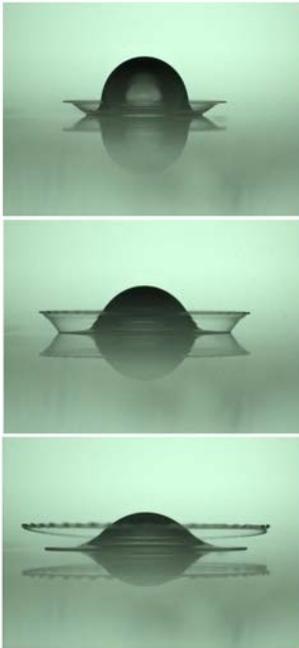
16.15 Conclusion

The UK Fluids Network

UKFN has now been up and running for one year, and it already involves many hundreds of UK fluids researchers. At its core are the 41 Special Interest Groups that UKFN has set up. Some of these may be of interest to PGS members. These SIG's cover a broad range of topics in fluid mechanics, with each one a world-class centre of expertise in its chosen speciality. Here you will find an overview of two of them extracted from their first UK Fluids Network booklet, dated Sept 2017. The website shows their planned activities and who to contact if you would like to join or just find out more. <https://fluids.ac.uk>

Drop dynamics

High-speed impact of a drop of ethanol onto a thin layer of the same fluid.



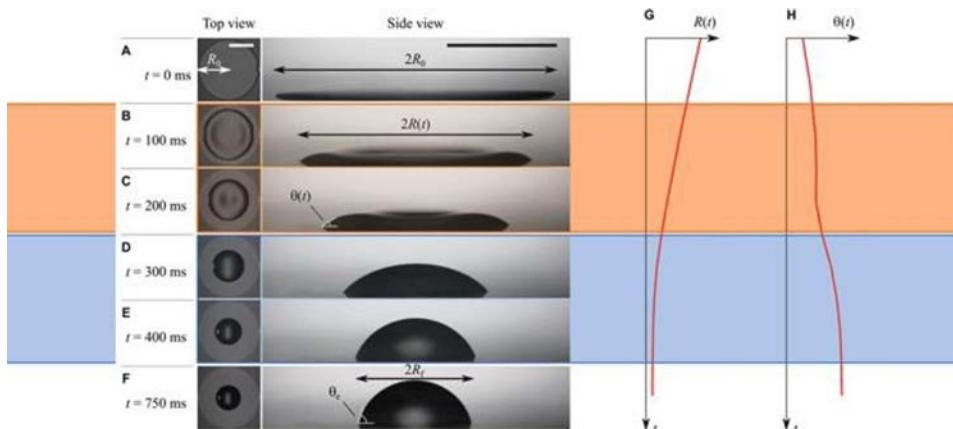
The study of liquid drops and the break-up of jets is important in several natural (physical and biological) and practical (technological) contexts, including defensive and hunting mechanisms of some animals, dispersion of liquid drugs into droplets for inhalation, crop- and paint-spraying, the manufacturing of biomaterials, and inkjet printing. The main objective of this SIG is to encourage discussion and establish collaborative networks around the topic of Drop Dynamics. We wish to bring together experimentalists, theoreticians and numerical modellers to study topics including (but not limited to!) pinch-off, drop formation and generation, coalescence, drop interactions, drop impact, spreading and splashing, evaporation, contact line dynamics, and applications of drops (inkjet, sprays, microfluidics, coatings, 3D printing). Membership of this group is open and aimed at researchers and students working in the field of droplets. Please, email us to be included on the SIG's circulation list. Our community offers an unmatched set of skills and expertise, ranging from fundamental theoretical

approaches and high resolution numerical modelling (DNS, Lattice Boltzmann and Molecular Simulations), through state-of-the-art experimental techniques (ultra-high-speed image visualisation and holography), to applied research (microfluidics, inkjet, spray/combustion, and biofluids).

Website: <http://www.eng.ox.ac.uk/fluidlab/sig-drop-dynamics>

Droplet and flow interactions with bio-inspired and smart surfaces

The dewetting of a liquid droplet from a smooth solid surface. (See: Edwards et al. Sci. Adv. 2016; 2: e1600183)



This interdisciplinary SIG aims to bring together researchers from Chemistry, Physics, Engineering and Materials Science with interests in cutting edge surface engineering/science phenomena. Our interest centres on fluid interactions with bioinspired and smart textured (e.g. ribbed, superhydrophobic, liquid-impregnated) surfaces. It includes both droplets moving across surfaces and flow adjacent to surfaces at different length scales and Reynolds numbers. Understanding such fluid flows undoubtedly requires techniques from bench-top in lab observation to large-scale flumes, and complementary modelling techniques. Applications are equally diverse. To promote the sharing of knowledge, ideas and research methodologies, our SIG schedules six monthly SIG meetings and thematic mini-symposia (e.g. on flow characterization, surface fabrication, and modelling). It is hoped that these events will leverage new collaborations leading to joint publications and grant applications. We have also planned dedicated PGR and ECR events to facilitate their professional development, as well as regular industrial networking events.

Website: <https://fluids.ac.uk/sig/SmartSurfaces>

Clothes that reveal how you really feel



Electronics and sensors woven into textiles and other wearables enable comfortable and reliable health monitoring

By Alan Hodgson, Chair, IEC TC 119: Printed Electronics

Smart textiles could save lives by monitoring aspects of health at work (Photo: Toyobo Co Ltd) In the image the electronics box mounted on the garment uses Bluetooth to transmit data, eg heart rate, temperature, blood pressure, from sensors in the textile to, say, a mobile phone.

International Standards for wearable electronics devices are now being actively worked on in a number of technical committees (TCs) within the IEC community.

Market sectors for wearable electronic devices

Printed electronics has applications in most of the following sectors: sport and wellness, commercial and industrial, military, consumer electronics, communications, apparel and medical and healthcare, but mostly within textile electronics and sensor fabrication. Printed electronics looks set to be a key technology in the future of wearable electronics as the market transitions from hard devices in plastic to flexible and conformable electronics – see **Connecting the printed electronics and wearables communities** in e-tech issue 05/2017. For example, wearable heart rate sensors, fabricated using printed graphene onto a cotton substrate combine textiles with sensors in order to give assemblies which are more flexible and comfortable than those available today.

The formation of [IEC TC 124](#) came out of an initiative from the IEC Standardization Management Board (SMB) (see [Printed electronics – The challenge of Systems Integration](#) in e-tech issue 01/2016) where a number of potential market sectors were identified.

Relevant areas of standardization

Standardization in the field of printed electronics takes place within [IEC TC 119](#) and has been summarized in *Printed electronics gathering pace* in *e-tech* issue 06/2017. Some of the work packages within IEC TC 119 have particular relevance to wearable electronic devices. For example, there is the ongoing work to standardize test methods for flexible and stretchable inks and substrates. IEC TC 119 has already published a Technical Report on the materials needed for printed electronics in wearable electronic devices, available as [IEC TR 62899-250:2016](#), *Printed electronics - Part 250: Material technologies required in printed electronics for wearable smart devices*. In addition, IEC TC 119 is working on test methods and procedures for product parameters, lifetime assessment and reliability testing of printed flexible gas sensors.

In the specific field of standardization of wearable electronics standardization has already commenced from IEC TC 124 within three working groups (WGs).

- WG 1 – Terminology is working on this single topic, an important area as there is a need to establish a common understanding of terminology to facilitate dialogue between stakeholders. IEC is in a unique position to set standardized terminology in this emerging area, with resources such as [Electropedia](#).
- WG 2 – e-textiles, an emerging area between electronics adapted for textiles and textiles adapted for electronics. This is also an area of overlap with IEC TC 119 as printing has a significant role in the fabrication of e-textile systems. Working Group 2 is working on a wash test method for leisure and sportswear e-textile systems, critical areas for the consumer market. These tests are important for consumer leisure and sportswear garments, because the end user has a legitimate expectation that any e-textile functionality will remain working after multiple wash cycles.
- WG 4 – devices and systems looks set to focus on the sensor elements in the near future, an area of significant interest across the IEC community – see [Sensor networks, wearable printed electronics and AAL](#) in *e-tech* issue 07/2016.

Liaison relationships for wearable electronic devices

Both IEC TC 119 and IEC TC 124 have established liaisons with [IEC TC 47](#): Semiconductor devices, and [IEC TC 110](#): Electronic display devices, as both these technologies will feature in printed and wearable electronics. Under discussion at the Manchester IEC TC 124 Plenary meeting was extending the liaison work with [IEC TC 101](#): Electrostatics, as a Technical Report on the implications for these technologies may be timely. Both IEC TCs also liaise with ISO technical committees and IEC also reaches out to external communities to integrate their work.

One group that has been particularly supportive of IEC standardization efforts is the Organic and Printed Electronics Association (OE-A) who have allowed IEC work to be presented at their meetings and have hosted IEC TC 119 Working Groups, extending the offer to IEC TC 124. Collaborations with such groups facilitate extending into new areas such as printable device encapsulation and the sustainability aspect of this work. Participation in the IEC Advisory Committee on Environmental Aspects ([ACEA](#)) may be the next step

Looking to the future

There are a number of communities as yet underrepresented in the IEC technical committee structure that will be important to move printed electronics for wearables towards industrialization, example the bioelectronics community. Bioelectronics is an interdisciplinary area focusing on the electronic monitoring and control of biological systems, and the engineering of the bio-interface.

IEC TC 124 started to explore this new area during second Plenary meeting, held in 2018 at the University of Manchester, UK. The university has a bioelectronics network and showed some initial assemblies featuring printed graphene. There were also some industrial examples from the Japanese delegation featuring the Toyobo Cocomi material. This looks likely to be a growth area for IEC TC 124.

New technologies such as this need new delegates to make progress. Many of these technologies have only recently emerged from universities and are often led by younger persons. Over recent General Meetings IEC TC 119 has been privileged to host delegates from the IEC [Young Professionals Programme](#), which has been developed to increase the involvement of upcoming electrotechnology experts and leaders in IEC work. We look forward to hosting further delegates at the 2018 meeting – they are key to our progress and the future of the IEC.

Conclusions

International standardization work in the field of wearable electronic devices has started within IEC TC 124. Printed electronics technologies from IEC TC 119 have a role to play in future wearable electronic devices and by working together we can facilitate both industrialization and standardization. We look forward to interacting with the wider IEC community at the 2018 General Meeting in Busan.

Originally published by [The IEC](#) (International Electrotechnical Commission), the world's leading organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

<https://iecotech.org/issue/2018-04/Clothes-that-reveal-how-you-really-feel>

The Wide Eye – the Sign & Digital show

Dr Alan Hodgson, Printing and Imaging consultant

The Wider Eye series of articles seek to look outside of the Authentication environment for technologies that could have influence on secure document systems. This article takes a look into the Sign & Digital trade show in the UK and finds some threats and opportunities for secure document features.

Sign makers and inkjet

We all use trade shows to gain information on new products and ideas. Typical forums for our print community are the large international shows like DRUPA and Intergraf. But sometimes it is worth taking a look at innovations in parallel print communities and one of these meets annually at the Sign & Digital trade show at the National Exhibition Centre in Birmingham UK.

As the name implies this trade show is aimed principally at sign makers. However, a number of the print solutions used in this sector have the potential to be applied to secure documents; unfortunately for both legitimate and illicit production.

Inkjet size and format

Walking around this show the breadth of production inkjet solutions available to small to medium sized print houses was very apparent. Roll to roll printers with print widths up to several metres were popular with applications as diverse as vehicle wraps and textile printing. Many of these also incorporate cutting systems that can convert the rolls into sheets after printing.

Moving away from the roll to roll production systems there are a number of other systems we should take note of. Sheet fed printers are seeing a resurgence in popularity, particularly with the high speed “page wide” systems (AN March 2016). But within the sign making community the most popular choice outside of roll fed are the wide variety of flatbed printers.

We should take careful note of the capabilities of these machines, from both a production and an illicit copying perspective. The flatbed machines in particular have the capability to print in high registration and are now being sold into the sign market for product enhancement specifically for the printing of texture. We will consider the implications of this later in this article.

Spot colour printing and more

Inkjet printers have long since evolved beyond simply printing four colour CMYK ink sets. Inkjet printers at this show typically featured 6-9 ink channels allowing the precise registration of a wide gamut of different colours, such as orange and green. It is no longer safe to rely on colour transitions such as orange to green to safeguard security print against illicit copying as the capability to formulate, print and colour manage such transitions is widespread within this community.

The breadth of these modern ink sets does not stop at spot colours. These ink sets can also incorporate white ink, light diffusing ink and varnish, allowing the printing of optical features such as gloss modulation into print solutions (AN April 2017). With up to 9 ink channels in the inkjet printers these units are designed to give the sign printers significant production flexibility.

The show also featured a number of inkjet ink manufacturers and dealers. Thanks to the wide industrial interest in inkjet printing as a manufacturing tool there is now substantial expertise in companies, research groups and universities on the formulation of stable ink formulations adapted to many different use cases and substrates. Many of these were on show at Sign & Digital as sign making has become a broad applications area.

Textiles of various forms now feature strongly as substrates for sign making, for applications such as building wraps and banners. Signage also has many challenges in common with secure documents such as the requirement for highly permanent print that is securely fixed to the substrate. As a result this industry has developed inks specifically for cellulose and polyester based substrates that should be of interest for those seeking paper or polymer card print solutions.

The continued evolution of UV cure

Many of the inkjet solutions featured at Sign & Digital utilised UV cure technology. This technology continues to develop, and two main areas of this evolution are of interest to secure document applications. The first of these is the gel or even solid inks, the second the printing of texture.

The inkjet printing process works by dispensing drops of low viscosity ink through a series of narrow nozzles. With some substrates this low viscosity can cause problems, such as the absorption of the ink into paper before curing. There now exists a solution to this in the form of UV cure inks that are high viscosity or even solid at room temperature.

These new generation of UV cure inkjet printers use print heads with substantial internal heaters, heating the ink before jetting to reduce the viscosity to a level that allows for effective printing. This solution has a number of advantages for the user. The key feature is that when the inkjet droplet hits the (comparatively cool) substrate it reverts to the high viscosity form, effectively pinning the droplets on the surface.

For the user this means that porous materials such as paper become much more accessible for these printers, giving the user a wider range of substrates. And because the droplets are immobilised by the temperature change there is much more leeway on the time between printing and UV curing, allowing for greater versatility in printer configuration (AN November 2015). And finally, it enables more solutions to the printing of tactile features.

The printing of tactile features

UV cure inkjet systems are capable of printing multiple stacked layers to a vertical height sufficient to make a digitally printed tactile feature – see AN April 2016.

These new generation of UV cure inks have the capability to build up successive layers cured ink of sufficient height to produce a texture that is similar enough to features like laser engraving and intaglio print. While we could consider some of these units to produce production print we should also remain aware of the potential for these units for illicit copying of tactile features – these printers are being sold into a large number of small sign shops.

This situation is likely to get more complicated in the near future as manufacturers target the market for painting reproduction or surface decoration where shape accuracy and surface smoothness are currently attracting great attention. At the moment production UV cure printers in general produce a surface roughness that increases with the printed height, making them moderately easy to identify using a reflection microscope or 10x hand lens. Advances in inkjet printing for texture reproduction may make this test obsolete in the future.

This UV cure technology may also be reviewed at a future High Security Printing meeting and in Authentication News.

In summary

This show illustrated the wide range of substrate sizes and print speeds that can be accommodated by off the shelf systems but it is not just the print systems themselves that should be of interest to secure document production. The ink and inkjet print head options demonstrated at this show illustrate the range of combinations that could be utilised as print engines integrated into larger print production systems. Additions such as these could significantly augment existing systems, adding further digital variable data print capabilities.

And finally, we should keep a close eye on developments in texture printing. In the medium term we should consider these as options for new production systems. But in the short term we should be cognisant of the capabilities of these printers to produce passable copies of existing tactile features.

Further information

The communities developing the technologies featured in this article meet to show their technology at a variety of conferences and exhibitions. My favoured conference choice to hear the technical advances and to meet the engineers working in this area is the IS&T Printing for Fabrication conference. In addition to the sessions on printing technology this meeting also features workshops and conference sessions dealing with Security Printing.

Printing for Fabrication is an international conference and this year meets in Dresden, Germany in September.

Sign & Digital is an annual show at the National Exhibition Centre (NEC), Birmingham UK..

This report on the **Sign & Digital trade show** originally appeared in the May 2018 edition of **Authentication News**.

Forthcoming Group Events

Science of Printing and Interfacial Phenomena

2 November 2018.

De Vere West One, London

[Link to Group Calendar. https://www.events.iop.org/e/science-of-printing-4b441ff1494143358759212f20787c1b/page.html](https://www.events.iop.org/e/science-of-printing-4b441ff1494143358759212f20787c1b/page.html)

Also

<https://www.iopconferences.org/iop/frontend/reg/thome.csp?pageID=787478&eventID=1274&traceRedir=2>

Student Conference

18 January 2019

Possibly IOP HQ London, UK

Organised by the PGS Group.

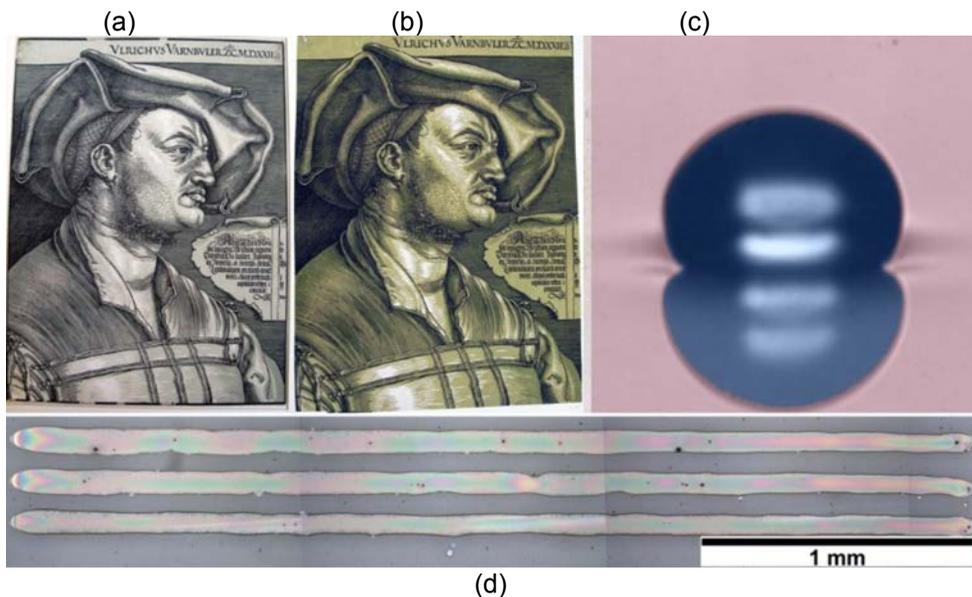
The Science of Printing: Revealing the past & building the future

Advance Notice, no date or venue decided to date. Co-sponsored by the PGS Group.

This is an early announcement about a meeting being organised for early 2019 that will bring together research leaders in historical printing and advanced future printing applications. Historical printed texts and images are not identical multiples but three-dimensional unique objects. They are an unexplored goldmine of information about the trade in artists' materials, chemical knowledge, formulation techniques and dissemination of technology. Understanding printed information itself as a unique artefact requires new methods and cutting-edge analysis used by chemists, materials scientists and engineers.

The modern printing industry is not only important for traditional graphical applications but is expanding rapidly to include applications involving advanced materials, such as sensors, electronics, pharmaceuticals, 3D printing and biomaterials. To enhance sustainability, there is also a growing focus on green chemistry solutions, using ingredients with minimal environmental impact. Researchers hunting for naturally sourced, biodegradable inks are looking for new de-foamers, viscosity modifiers, solvents, pigments etc. Late medieval printing inks were necessarily restricted by default to local, sustainable, and organic ingredients, and modern industry needs access to lost knowledge they represent. This meeting will bring together researchers thinking about printing with both historical and futuristic contexts, to learn from each other about materials,

analysis techniques, sustainability and the cultural importance of the innovations that this industry has delivered.



- (a) Albrecht Dürer, Ulrich Varnbüler, woodcut (Nuremberg: 1522),
(b) later edition with two tone blocks (Amsterdam: Willem Janssen Blaeu, c.1630). Amsterdam, Rijksmuseum.
(c) printing to liquids for drug delivery (2018)
(d) printing nanoparticles for biosensing

This meeting will be convened by researchers at School of Advanced Study (University of London), the Institute for Manufacturing (University of Cambridge) and the Library of Congress.

More information will be shared in the near future. Please forward any questions to: irc-enquiries@eng.cam.ac.uk

Other Events of Potential Interest

IS&T Archiving 2019 Conference

Digitization Preservation, and Access

14-17 May, 2019

Lisbon, Portugal

Organised by the Society for Imaging Science and Technology.

http://www.imaging.org/site/IST/IST/Conferences/Archiving/Archiving_Home.aspx

The IS&T Archiving Conference is an annual event for the imaging science and the cultural heritage communities. It enables scientists, technicians and those working in the cultural heritage community (curators, archivists, librarians, etc.), government, industry, and academia to discuss the latest research and issues relating to the digital preservation and stewardship of hardcopy, audio and video. There is still time to submit for this conference. Deadlines 1st and 22nd Nov. 2018.

IARIGAI 45nd Annual Conference

3rd-7th October 2018

Warsaw, Poland.

<http://iarigai.com/warsaw-2018/>

14th Colour Conference

11-12 September 2018

Florence, Italy

<http://www.gruppodelcolore.it>

Printed Electronics USA 2018

November 14 - 15

Santa Clara Convention Center, CA, USA

<https://www.idtechex.com/printed-electronics-usa/show/en/>

Printed Electronics Europe 2019

10 - 11 April 2019 |

Berlin, Germany, Estrel Convention Center,

<https://www.idtechex.com/printed-electronics-europe/show/en/>

RPS Good Picture 2018: Imaging Deconstructed

08 December 2018

University of Westminster, 309 Regent Street, London, UK

<http://rps.org/events/2018/december/08/good-picture-2018--imaging-deconstructed>

Electronic Imaging 2019

13-17 January 2019

Burlingame, California, USA

http://www.imaging.org/site/IST/IST/Conferences/EI/Symposium_Overview.aspx

Large-area, Organic & Printed Electronics Convention (LOPEC)

19-21 March 2019

Munich, Germany

<https://www.lopec.com/>

Reconnaissance International Digital Document Security

13-15 May 2019,

Berlin

The Call for Papers for this conference remains open through October.

www.digitaldocumentsecurity.com

Awards

PGS Group Awards

The PGS Group award student presentation prizes each year. These prizes are open to all research students currently undertaking work at a university in the UK or Ireland, leading to a PhD or Masters degree, who present their work at the annual Printing and Graphic Science Group Student Conference. The Group awards of £50 for the two best Student Presentations.

All presentations given at the Student Conference are considered for prizes. For information on next year's conference please see our group calendar. The 2018 Student Presentation Prizes were awarded as below. Unfortunately the projector was left on at the time.

Jack Hinton: Hybrid Additive Manufacturing of Precision Engineered Ceramic Components.



Yaan Liu: Additive manufacture of 3D metal-polymer nanocomposites by simultaneous multiphoton polymerisation and photoreduction



And, as the projector was unkind, here is a photo without that fault. It shows our Chair, Dr Emma Talbot..



Research Student Conference Fund

http://www.iop.org/about/grants/travel-bursaries/research_student/page_38808.html

Optics of Liquid Crystals 2017

In 2017 the Group sponsored Ellis Parry to attend the 17th Optics of Liquid Crystals 2017 Here is his Conference report on OLC 2017.

I would like to thank the IOP and the Printing and Graphics Science Group for the generous offer of funding I received to attend this conference in Sao Paulo, Brazil. The event was packed full of high-profile and interesting talks and the experience was made all the more memorable due to the fantastic location and venue. This was my second time presenting at an international conference and a great opportunity to present my ideas to leaders in my research field. There was a broad focus to the conference, with lectures on many different applications, analysis and theory of liquid crystals. I find this particularly stimulating for my own research as it gives me the stimulus and the space to generate new ideas for my own research.

The conference started well with a fascinating invited talk from Dr T. J. Bunning entitled "Dynamic Polymer/Liquid Crystal Composites". My research is focussed on the fabrication of liquid crystal/polymer composite devices using inkjet printing, so this talk, which was sweeping in scope, was particularly relevant. Having concentrated my research on device fabrication, it was invaluable to listen to an industry expert (US airforce) talk about the real-world application of such composite devices. Specifically, he concentrated on the use of liquid crystal/polymer shutters for developing 3D volumetric displays. This is an alternative method for producing glasses-free 3D displays, which have previously been done using lenticular switchable liquid crystal arrays, something my most recent research has gone into fabricating using printing technology.

In a similar way, the talk from Prof. V. Chigrinov was very beneficial to my own research, as well being a very motivational talk concerning the future of the liquid crystal field. He had fabricated 2D/3D switchable lenses that were produced by the photoalignment technique. These lenses have a similar function to the microlenses I discussed in my own talk entitled "Drop-on-Demand Ink-jet Printing of Tunable Liquid Crystal Microlens Arrays" and it was very beneficial listening to his talk and discussing ideas over the coffee breaks and lunches.

During the conference, I also made a valuable acquaintance with a research scientist who works on the modelling of liquid crystal microlenses for display applications. He wasn't presenting so it was very lucky to meet him and we have agreed to discuss future collaboration. My work focuses on the efficient manufacture of the very lenses he models; thus the collaboration could be very beneficial to the both of us.

Although I was nervous before giving my own talk it was the perfect environment to do so. I felt as though I articulated my material well, no doubt this was contributed to by the beautiful and relaxed setting of the Guarujan beach-side, which did seem to put everybody into a positive and encouraging frame of mind. Overall, I feel the conference was a big success from both the perspective of my own research and that as a conference as a whole. I developed and discussed new ideas, a few of which I am now pursuing in my research. There is the real prospect of a valuable collaboration resulting from a coffee conversation. I have gained confidence presenting in front of experts in my field. Finally, my colleagues and myself had a lot of fun chatting, socialising and doing science with fellow researchers from all over the world.

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The Institute of Physics, 80 Portland Place, London W1B 1NT, UK.

Tel: 020 7470 4800

Fax: 020 7470 4848