Printing for Fabrication
Materials, Applications, and Processes

September 12 – 16, 2016
Manchester, United Kingdom

General Chair: Brian Derby, University of Manchester

Early Registration Deadline:
August 14, 2016

www.imaging.org/manchester

Collocated event
2016 International Symposium on Technologies in Digital Photo Fulfillment
Special Focus on Photobooks
Cosponsored by The Royal Photographic Society

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There is still time to become an Exhibitor and/or Sponsor. Contact Donna Smith (dsmith@imaging.org) for details.

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Printing for Fabrication 2016

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Technologies in Digital Photo Fulfillment 2016

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Keep up-to-date on the details of these meetings! Join the NIP (Digital Printing)/Digital Fabrication Conference Group on LinkedIn!
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All photos contained herein: Suzanne Grinnan.
Welcome to Manchester, UK

Week At-a-Glance

Monday, Sept. 12
- Short Courses
- Welcome Reception at Manchester Town Hall

Tuesday, Sept. 13
- Opening Keynote: Kostya Novoselov, University of Manchester, Materials in the Flatland
- Technical Sessions
- Exhibition
- Demonstration Session
- Young Professional/Student Social Event

Wednesday, Sept. 14
- Keynote: Henning Sirringhaus, University of Cambridge Low-Temperature Organic and Oxide Transistors for Printable Electronics
- Technical Sessions
- Exhibition

Thursday, Sept. 15
- Keynote: Hideki Kyogoku, Kindai University, The Objectives of a National Project of ‘Manufacturing Innovation through Development of Next Generation 3D Printers’ in Japan
- IS&T Awards
- Technical Sessions
- Interactive Paper (Poster) Sessions
- International Symposium on Technologies in Digital Photo Fulfillment 2016
- Connections for Innovation in Security Printing Workshop
- Conference Reception at Museum of Science and Industry (MOSI)

Friday, Sept. 16
- Keynote: TBA on BioPrinting
- Technical Sessions
- Technology Tours

Printing for Fabrication
Print-based fabrication, functional materials, and applications: Writing the next chapter

The printing industry continues to move forward. Familiar digital printing technologies continue to advance, particularly in the area of high-speed and single-pass output. New applications mean print quality, color science, image processing, and workflow continue to be active areas for improvement. Concurrently, technologies that extend beyond marks on paper are playing an increasingly important role in redefining what it means to print something.

Printing for fabrication—essentially adapting traditional printing technologies to produce and manufacture functional two- and three-dimensional functionality for a wide range of applications from packaging to bio-mechanisms—is an increasing focus of R&D. These new printing modalities are poised to become the disruptive technologies of future manufacturing.

Advances in nanotechnology and material science are a critical component in this transition. Both play a significant role in advancing printing with the introduction of new toners, inks, and substrates, as well as the facilitation of new additive manufacturing and bio-fabrication technologies such as high-performance electronic and photovoltaic devices, highly-sensitive chemical and biological sensors, and even bio materials and structures. These changes may be the catalyst for a new industrial revolution.

Like the printing industry, the IS&T Printing conference continues to evolve. The traditional NIP and Digital Fabrication communities have routinely shared and repurposed new ideas and concepts, exploiting the synergy between delegates. As “Printing for Fabrication” this journey continues, bringing together printing ecosystem practitioners—academics, researchers, developers, manufacturers, distributors—to a location beyond North America. This 32nd meeting takes place on the campus of the University of Manchester in the United Kingdom. With a strong UK community and academic presence in this field, and proximity to the wider European community, this will be a fascinating meeting.

This conference also brings a new initiative. For the first time the meeting hosts the IS&T International Symposium on Technologies for Digital Photo Fulfillment (TDPF). TDPF 2016 joins with The Royal Photographic Society to offer sessions on photo-books, other applications, and the technologies that drive the digital photography ecosystem, from capture to fulfillment.

Come join us in Manchester and be part of the next wave of the future of printing!

—General Chair Brian Derby and Executive Program Chair James Stasiak
Hotel and Travel Information

IS&T has arranged for a number of hotel options within walking distance of the Renold Building, University of Manchester. All the hotel rates include wifi, breakfast, and VAT. For reservations visit: https://aws.passkey.com/g/57539537 Reservation Deadline: 14 August 2016 (Note: Malmaison deadline is 20 July 2016)

NOTE: If you do not find the dates you need at the hotel you want, contact abs@visitmanchester.com. Most of the hotels are offering more dates than shown in the web interface. Visit individual hotel websites for additional details.

The Palace Hotel: Headquarter hotel for the conference. Historic building with lovely rooms; ~10-minute walk to the Renold Building. www.palacehotelmanchestercity.co.uk/

Malmaison Hotel: Historic building across the street from Piccadilly Station; ~15-minute walk to the Renold Building.

Doubletree by Hilton Manchester: Contemporary hotel across the street from Piccadilly Station; ~15-minute walk to the Renold Building.

Inside Manchester: Hip, Euro-chic hotel close to Deansgate Station; ~20-minute walk to the Renold Building.

Jury’s Hotel: Close to Deansgate Station and shopping; ~20-minute walk to the Renold Building.

Ibis Hotel Princess Street: Budget hotel; ~5 minute walk to the Renold Building.

Ibis Hotel Portland Street: Budget downtown hotel; ~20 minute walk to the Renold Building.

Travel Details

Attendees may fly directly into Manchester Airport (MAN), London, or other major UK city. Train service between cities is frequent and reliable. Note that if you fly into London, you need to get to Euston Station to take a train to Manchester (see below).

MAN (www.manchesterairport.co.uk/) offers more than 200 direct flights, including from Amsterdam, Atlanta, Barcelona, Beijing, Berlin, Brussels, Chicago, Dubai, Frankfurt, Geneva, Hong Kong, London, New York, Newark, Paris, Philadelphia, Singapore, Tel Aviv, Washington DC, and Zurich.

Getting to/from Manchester from the Airport

Follow the signs in the terminals to the train station. Depending on where you land, it is anywhere from a 5- to 25-minute walk. There are frequent trains from MAN to Manchester Piccadilly Station. Fares vary depending on time of day, but are in the £5-10 range; times vary from ~13-25 minutes.

Getting to Manchester from London

Direct trains leave from London Euston Station to Manchester Piccadilly Station every 20 minutes beginning on the hour. Journey time is just over 2 hours. More info: www.thetrainline.com/train-times/london-to-manchester and www.virgintrains.co.uk. Fares vary depending on date and time of day. Note: There are no direct trains to Manchester from any of the London airports. It is possible to take a train from London Heathrow, Terminal 1 or 4, to Manchester. The train requires transfers and picks up the Manchester train at Euston Station. Internet searches reveal various options.

Getting Around Manchester

The Renold Building and most of the hotels are easily accessed on foot. For those lying a bit further, Manchester offers an extensive bus system and three FREE Metroshuttle buses (routes 1, 2, and 3) that leave from/arrive at Piccadilly Station and traverse the city. More information at: www.manchester.gov.uk/transport/Metroshuttle.aspx. Explore Manchester’s transport system at www.manchester.gov.uk/transport/default.aspx.
Venue and Special Events
Welcome to the European City of Science 2016

The Venue
Manchester, United Kingdom
2016 European City of Science

Manchester has a rich history steeped in innovation—much of it originated with the processing of raw cotton and the production of cotton goods during the industrial revolution. The engineering firms that initially made machines for the cotton trade diversified into general manufacturing, as did the chemical industry, which began by producing bleaches and dyes before expanding into other areas. A natural outgrowth of this commercialization was the establishment of university and college programs that advanced science, engineering, and invention. As such, Manchester can lay claim to 25 Nobel Prize laureates, including Niels Bohr, James Chadwick, Ernest Rutherford, and Andre Geim and Konstantin (Kostya) Novoselov, for groundbreaking experiments regarding the two-dimensional material graphene. This sense of innovation and ingenuity continues to this day, making Manchester a dynamic and interesting city to visit. Novoselov will present the opening keynote at this year’s conference.

Renold Building, University of Manchester
All short courses and technical sessions will take place in the Renold Building on the University of Manchester campus. Social and auxiliary events will be held at interesting locations around the city.

Special Events

Welcome Reception
Manchester Town Hall
Monday, September 12, 18:00 – 19:30

Completed in 1877 and regarded as one of the finest examples of Neo-Gothic architecture in the United Kingdom, the Manchester Town Hall is the perfect setting for sharing a drink and some nibbles with colleagues.

Student and Young Professionals Event
Pub Crawl, Pool, and Ping Pong
Tuesday, September 13, 19:00 – whenever

Experience first-hand why the UK is known worldwide for its pub culture and beer! Students from University of Manchester will lead a pub tour of the hip, Northern side of the city to fellow students and young professionals. Note the drinking age in the UK is 18; be prepared to show ID. Your first round is on the conference; after that you are on your own.

Security Printing Workshop
Connections for Innovation in Security Printing
Thursday, September 15, 14:30 – 17:30

The aim of this workshop is to connect and build collaborations around new printing technologies for high value security documents and products. The goal is to bring together a network of participants from industry, government, and academia. It will focus on connecting the technical challenges faced by the industry and government with the resources of universities and start-up companies.

After invited short presentations on the topic it is envisaged that group discussion(s) will build on this.

continues on next page
Special Events con’t.

Conference Reception
Museum of Science and Industry (MOSI)
Thursday, September 15, 19:00 – 22:00

Partially housed in a former British Rail station that was built in 1830, MOSI has an extensive collection delving into the technological and industrial developments that have come out of Manchester. Attendees will be able to learn about Manchester’s rich industrial history by touring Revolution Hall, Textiles Gallery, and Power Hall—all while enjoying food, libations, and good conversation.

2016 International Symposium on Technologies in Digital Photo Fulfillment
Special Focus: Photobooks
In cooperation with the Royal Photographic Society
Thursday, September 15, 15:00 – 17:30
Friday, September 16, 10:10 – 15:00

The digital photographic ecosystem—image capture, processing/organizing images, and soft/hard copy output of images—is the overall focus of this conference, now in its seventh year.

With our special focus on the life cycle of photo books, this year’s conference offers talks on materials and technologies that enable, encourage, and help people preserve their stories.

TDPF offers a unique opportunity for product engineers, researchers, photographers, and printers to meet and discuss the advances, synergies, and future directions of creating, printing, sharing, displaying, and archiving consumer and professional photos and photo-related products.

Technology Tours
Friday, September 16, ~15:30 – 17:00

The University of Manchester is uniquely positioned to provide a number of interesting tours to participants. Tours are open at no cost to all conference attendees; attendee guests may attend if space allows.

IS&T has arranged for five tours to be held Friday afternoon based on various areas of interest:
• Graphene: Visit the facilities of the UK National Graphene Institute.
• Printing: Visit the Centre for Digital Fabrication via a tour that goes to the Fabrication, Bio-printing, and inkjet printing laboratories across the campus.
• Imaging and characterization tools: Visit the 4D Imaging Centre, part of the Photon Science Institute.
• Textiles: Visit the faculties dedicated to functional textiles.
• Preservation: Housed in a late-Victorian neo-Gothic building, the John Rylands Library houses one of the UK’s largest special collections. Participants in this tour see the library’s photo and heritage imaging collection.


Fish, chips, mushy peas, and a pint—a staple in the pubs of Manchester.
Short Course Program

The conference Short Course Program offers a wide range of introductory and advanced classes in the fields of digital printing and fabrication given by internationally recognized experts. Attendees receive e-copies of the instructor’s notes with course registration. We encourage you to sign up for short courses by the early registration deadline to ensure that a course runs.

Please Note: IS&T reserves the right to cancel short courses in the event of insufficient advance registration. Please indicate your interest early.

Monday September 12, 2016

8:00 – 10:00

SC01: An Introduction to Digital Fabrication: Methods, Materials, and Applications
Monday 8:00 – 10:00 (2 hours)
Instructor: James W. Stasiak, HP Inc.

During the past decade, there has been a remarkable convergence of two disparate technologies: digital printing of text and images and the fabrication of physical objects. This convergence, a blending of traditional printing methods with recent advances in materials science and with established manufacturing methods, has brought about the foundation of a new technology: digital fabrication. Already, digital fabrication approaches are enabling new discoveries at the laboratory bench and are beginning to provide new efficiencies and unprecedented product customization on the manufacturing floor. In the near future, digital fabrication methods—along with the development of “functional inks”—will make it possible to print complete electronic circuits, optical devices, mechanical structures, and even new biological materials. The objective of this short course is to provide an introduction to the rapidly emerging science and technology of digital fabrication. The course includes an up-to-date overview of the methods, materials, and processes that are reshaping manufacturing and enabling new commercial applications in electronics, MEMS, and the life sciences. Finally, the class examines factors that are moving digital fabrication from a niche technology toward a new manufacturing paradigm.

Benefits
This course enables an attendee to:

• Develop an understanding of different digital fabrication methods and materials.
• List and compare different applications that range from printed electronics to the life sciences.
• Evaluate the technological issues and challenges of digital fabrication.
• Develop an understanding of the technology landscape, key players, and practitioners.

• Recognize the market opportunities addressed by this emerging technology.

Intended Audience: this is a survey course for engineers, scientists, and technical marketing professionals who are working or are interested in digital fabrication and printed electronics.

James Stasiak is currently a principal scientist in HP’s Technology Development Laboratory in Corvallis, Oregon. He is actively involved in developing new digital fabrication methods and applications. In a career spanning more than 30 years, he has made contributions in the fields of device physics, molecular electronics, non-impact printing technologies, and, more recently, the emerging fields of flexible electronics and digital fabrication. In 2005 and 2006, he served as the general chair for the Digital Fabrication Conference; in 2015 and 2016 as the Executive Program Chair for NIP and now Printing for Fabrication. He holds more than 14 issued US patents and is the author or editor of numerous technical articles and proceedings.

SC02: Inkjet Pigment and Dispersion Technology
Monday 8:00 – 10:00 (2 hours)
Instructor: Alan Hudd, Alchemie Technology Ltd.

This course describes the inkjet ink design process and requirements for successfully and reliably using a wide range of organic and inorganic pigments for inkjet printing. Methods of pigment stabilization are discussed. Details of dispersion technology and DVLO theory are used to highlight the importance of chemically stabilizing the surfaces of pigment particles. The Stokes-Einstein equation describing Brownian motion and Stokes law describing gravitational settling are used to understand the inkjet pigment ink requirement for flocculation and not agglomeration. Practical examples of processing pigment dispersions and typical and the types of chemical dispersants used in inkjet formulations are also be presented.
Benefits
This course enables an attendee to:
• Understand the key challenges involved in preparing a pigment ink for use in inkjet printing.
• Appreciate DVLO theory.
• Consider the factors that influence long-term stability.

Intended Audience: material scientists, print professionals, and engineers interested in ink preparation.

Alan Hudd, formerly with Domino and Xennia, now leads Alchemie Technology, which provides a wealth of industrial inkjet experience with a strong commercial awareness of the drivers and benefits of digital technology. Hudd has more than 30 years’ experience in the inkjet printing industry.

SC03: Liquid Toner Printing: Technology and Applications
Monday 8:00 – 10:00 (2 hours)
Instructor: George Gibson, PARC, Inc., a Xerox Company

DRUPA this year again focused attention on liquid toner. Liquid toner technologies have long been held as versatile methods for imaging in a variety of applications. Known for high image quality, especially high-quality color, liquid toners are undergoing a renaissance. Important applications beyond document printing include a number of industrial printing, display, and fabrication applications. In spite of demonstrated strength, liquid toners are employed in a minority of printing systems today. This course explores how the fundamental strengths of this technology have led to this current state and project where liquid toner will continue to be a vibrant force. The course covers the variety of liquid toner processes that are and have been used, including the strengths and limitations of each, and the major application areas in which these techniques are employed. An analysis of improvements of liquid toner systems found in recent technical literature and patents is presented. Participants receive a copy of several chapters of the instructor’s forthcoming book, Liquid Toner Printing.

Benefits
This course enables an attendee to:
• Recognize the fundamentals of five generations of liquid toner device architectures.
• Appreciate the composition and preparation methods for liquid toners.
• Describe how the components of the toner and characteristics of the process drive print properties.
• Identify the major market applications where liquid toners are used today.
• Have a vision of where liquid toner technologies are fundamentally advantaged.
• Learn about recent innovations in liquid toner technology.

Intended Audience: technical professionals who want to become more knowledgeable about liquid toner printing technology.

George A. Gibson is director, market development at Xerox’s storied Palo Alto Research Center. He has led research, development, and manufacturing organizations involved in non-impact printing for more than 30 years. Originally trained as a chemist, he did his undergraduate and graduate work at Binghamton University. He holds an MBA from the University of Rochester’s Simon Graduate School of Business. Gibson has 54 US patents and has written more than 20 published papers on imaging and colloid science and the management of research and development. He is a frequent lecturer on imaging technology, R&D productivity, portfolio management, and technology valuation. Recent invited lectures include “Good, Fast Cheap in New Product Development: Don’t Settle for Just Two,” and “Creative Destruction: Portfolio Renewal Rate and Returns Optimization.” Gibson is the author of a forthcoming book: Finding the Golden Eggs: An R&D Professional’s Guide to Managing New Product Development through Valuation.

SC04: Inkjet Drop-on-Demand Printheads
Monday 8:00 – 10:00 (2 hours)
Instructor: Mike Willis, Pivotal Resources, Ltd.

There is now quite a range of inkjet printheads from different manufacturers available to developers of new printers and processes. These vary not only in print width, drop volume, nozzle density, and drop frequency, but also in the materials that can be jetted. It can be difficult to substitute one printhead for another once a printer has been developed, so choosing the best technology for an application should be done carefully. This course reviews the main printheads available on the market, explain what’s going on inside them in order to generate drops, and discusses the materials and manufacturing methods used.

Benefits
This course enables attendees to:
• Understand the different actuator configurations used in inkjet printheads.
• Evaluate the performance of printheads through an understanding of issues such as crosstalk.
• Understand terminology used such as frequency response and how to interpret it.
MONDAY SHORT COURSES

| SC01: An Introduction to Digital Fabrication: Methods, Materials, and Applications | SC02: Inkjet Pigment and Dispersions Technology | SC03: Liquid Toner Printing: Technology and Applications | SC04: Inkjet Drop-on-Demand Printheads |

- Appreciate life issues and restrictions on printhead use.
- Learn why printhead performance can vary from nozzle to nozzle.
- Gain insight into why printheads from different manufacturers, with the same basic specifications, behave differently.

**Intended Audience:** scientists, engineers, and chemists already familiar with inkjet, who seek to learn more about the hardware they are using.

Mike Willis founded Pivotal Resources, a digital printing industry consultancy, in 1995. He has experience in a wide range of technologies and markets including drop-on-demand and continuous inkjet printing, electrophotographic technology, greyscale and color reproduction methods, and light sensitive materials. He was a founder member of Xaar—a spin-off company from Cambridge Consultants—and before that spent six years at Gestetner developing copiers. He graduated from the Polytechnic of Central London with an honours degree in photographic sciences.

**10:15 – 12:15**

**SC05: Insight into New Inkjet Technological Developments from Patent Literature**
Monday 10:15 – 12:15 (2 hours)
Instructor: Mike Willis, Pivotal Resources, Ltd.

There are around 300 new patent applications published each month that can give an insight into new developments. However searching for these patents, then filtering out the most interesting ones, is time consuming. Having followed inkjet patents since the 1980s and regularly monitoring patent applications since 1997, Willis brings great insight to the subject. This course reviews some of the developments that Willis has seen over the past two years, in particular encompassing printhead and system technology such as ink supplies, nozzle maintenance, drop detection, etc. The assessment includes thermal inkjet, Landa Digital and other transfer processes, challenges for high-speed printing—such as misting, condensation, and missing nozzle detection and correction—and new applications such as flooring, footwear, and cosmetics.

**Benefits**
This course enables attendees to:
• Appreciate the value of the information contained within patent literature.
• Understand the limitations of patent research to avoid false interpretations.
• Understand and benchmark the state-of-the-art in areas examined.
• Understand some of the issues being faced at the forefront of technology development.

**Intended Audience:** anyone interested in what inkjet developments are taking place that are not yet commercialized, such as scientists, engineers, program and business development managers.

See bio under SC04: Inkjet Drop-on-Demand Printheads

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20% SAVINGS

Take 3 or more courses and get 20% off your total short course registration fee!
See registration form for details.
SC06: Colorants for Inkjet Applications  
Monday 10:15 – 12:15 (2 hours)  
Instructor: Alex Shakhnovich, Cabot Corporation

This course is an introduction to available colorant choices for office and commercial inkjet printing with focus on three areas: colorants for inkjet applications, dispersion methods, and failure modes in inks and during printing. The first part addresses the choices of color pigments available to the industry. Specific attention is paid to yellow pigments, as the most challenging components of CMY color triad. Using dyes as complements to pigments is also covered. Next, two principal dispersion methods—surface modification and using polymeric dispersants—are covered. Advantages and drawbacks of both approaches are discussed in-depth. Finally, colorants failure modes in inks during storage and during the printing process are detailed. The fastness properties of color pigments is also addressed.

Benefits
This course enables an attendee to:
• Intelligently choose the colorants for inkjet inks, understanding differences in properties and tradeoffs.
• Understand what questions should be addressed when selecting colorant(s) for a new application or a retrofit.
• Become familiar with major technologies used for preparing inkjet dispersions.

Intended Audience: those working in technical and commercial areas who desire a fundamental understanding of pigment chemistry and selection of pigment dispersions for inkjet printing.

Alex Shakhnovich is a Research Fellow at Cabot Corporation in Billerica, Massachusetts. He has more than 40 years of experience in chemistry and application of colorants for plastics, textile, and inkjet. His specific focus at Cabot is preparation of surface-treated organic pigments. He has been awarded 10 US patents in inkjet area. Shakhnovich received his MS in chemistry from Moscow State University and his PhD in heterocyclic chemistry (1979) from Institute of Dyes and Intermediates (Moscow, Russia). Shakhnovich is a co-author of the chapter Pigments for Inkjet Applications in The Chemistry of Inkjet Inks (World Scientific Publishing Co., 2010). His research interests include synthesis, surface modification, and application of organic colorants.

SC07: Digital Textile Printing: Applications, Markets, and Technology  
Monday 10:15 – 12:15 (2 hours)  
Instructor: Tim Phillips, IMI Europe Ltd.

The course reviews the exciting advances in digital textile printing using inkjet technology. It starts with an overview of the industry and its market dynamics, including the value chain and key players, as well as factors promoting and limiting its adoption. The course surveys the key digital textile printing application areas. For each application area and fabric type, the required ink, processing, and fixing technology is reviewed. A more in-depth discussion of ink technology, including colorants and formulation, with a comparison of dye-based and pigment printing, follows. Finally other aspects of digital printing of textiles, including printhead choice, fabric handling, printer configuration options, and print quality are presented.

Benefits
This course enables attendees to:
• Gain an understanding of the main application areas contained within digital textile printing.
• Appreciate the market dynamics relevant to these application areas.
• Learn about the main ink, printing and processing technology required for digital textile printing, as well as some of the challenges and opportunities presented.

Intended Audience: technical, semi-technical, or business related job roles interested in the technology behind digital textile printing and what is causing the rapid growth in adoption.

Tim Phillips holds a degree in natural sciences from the University of Cambridge, a PhD from the University of Bristol, and an MBA from the University of Warwick. Previously Phillips was responsible for the textiles business at leading inkjet supplier Xennia Technology, recently acquired by Sensient Technologies. He is now managing director of IMI Europe, provider of inkjet conferences and courses, and founder of technology marketing consultancy Catenary Solutions.

SC08: Fabrication Materials & Processes of Inkjet Printheads  
Monday 10:15 – 12:15 (2 hours)  
Instructor: Hue Le, Le Technologies Inc.

In recent years, enormous progress has been made in the design, fabrication, and commercialization of inkjet printing systems. This short course describes the materials and processes that have been used to produce various inkjet printheads, which are the core component of the printing
systems. Methods of forming inkjet nozzle, anti-wetting coated nozzle surface, ink channel and chamber, and various bonding methods are then reviewed. Materials of thin film resistor (for thermal inkjet) and piezoelectric ceramic (for piezoelectric inkjet) are also reviewed. The course concludes with insights into the potential material interactions between the more complex jetting fluids and the printhead structures in several emerging applications such as bio-printing and printed electronics.

**Benefits**

This course enables an attendee to:

- Understand different 3D biofabrication techniques and materials.
- Understand the opportunities and challenges in 3D biofabrication.
- Apply 3D biofabrication technology to tissue engineering and novel applications.

**Intended Audience:** anyone interested in 3D biofabrication and tissue engineering.

Dr. Wenniao (Will) Shu is a professor of biomedical engineering in the Department of Bioengineering, University of Strathclyde in Glasgow. He led the research to demonstrate the first bioprinting of human pluripotent stem cells, paving the way for their applications on animal-free drug testing and 3D printed organs. His research interests cover a range of biomedical engineering topics including 3D biofabrication, lab-on-a-chip, biosensors, and their applications for tissue engineering and drug testing.

**SC10: Fluid Dynamics and Acoustics of Inkjet Printing**

Monday 13:30 – 15:30 (2 hours)

Instructor: J. Frits Dijksman, University of Twente

Inkjet printing is a process of depositing on-demand droplets with a well-defined volume on a precisely given location on a substrate. The course is restricted to piezo driven print heads. A piezo driven print head is a set of closely packed acoustic cavities, each cavity partly covered with a piezoelectric actuator, of which the fluid dynamical and acoustical characteristics will be presented in the time and frequency domain. The process starts with generating electric pulses to selected piezoelectric actuators. In the connected cavities pressure waves are introduced. At the nozzles these pressure waves are changed into velocity waves. In case such a velocity wave is sufficiently intense, droplet(s) are formed.

The process ends with droplet landing, being a highly dynamic phenomenon, with its own timing characteristics. The aim of this course is to couple the characteristics of droplet formation and landing to the acoustics of the fluidics of the print head behind the nozzle all the way up into the ink supply. Special attention will be paid to fluidic cross-talk in multi-nozzle print heads and the jetting of viscoelastic inks.

**Benefits**

This course enables an attendee to understand the interactions between the acoustics of the fluidics of the print head and the characteristics of piezo inkjet droplet formation, landing, spreading, and permeation.
**Printing for Fabrication 2016**

**Intended Audience:** engineers and scientists interested in piezo driven print heads, students in the area of print head physics, engineers and scientists working with biomedical applications of inkjet technology.

Frits Dijksman is professor in the field of innovative biomedical applications of inkjet technology at the University of Twente, the Netherlands. He has worked with Philips Research for more than 30 years and his main area of interest has been inkjet technology for consumer and non-consumer applications, such as PolyLED display manufacturing and the printing of biomolecules.

**SC11: Fusing Physics and Technologies**
Monday 13:30 – 15:30 (2 hours)
Instructor: Dinesh Tyagi, Lexmark International, Inc.

In spite of the numerous technological advances that have been made in the areas of toner development and rendering schemes, the final image quality is ultimately determined by the customer holding the final print. From image gloss to color reproduction, and including print physical performance, the final properties are directly dictated by the fusing step.

Most conventional electrophotographic printing systems require a fusing sub-system that takes the discrete toner particles and both fuses (coalesces) them together and fixes them to the media. This process is required to produce an attractive, durable image that is bonded tightly to the substrate. This course reviews the fundamental functions of fusing and details past and current fusing technology trends in the electrophotographic industry. The physics of each fusing technology is discussed, with a specific focus on each technology’s strengths and weaknesses. Physics and mathematical models of thermal fusing are described along with the critical parameters in fusing steps. In the later part of the course, the most common fusing technologies are discussed, covering the critical parameters and failure modes that govern each fusing methodology. The course also covers the scientific and engineering challenges that are faced during both the technology and product-development cycles of a fuser. Common tests for image permanence are discussed along with the available options to enhance print physical performance.

**Benefits**
This course enables an attendee to:
- Identify and comprehend advantages and disadvantages of different fusing technologies that have been developed and used throughout the industry.
- Analyze the critical parameters that define the fusing process and latitude for common fusing technologies.
- Determine the critical failure modes, and the critical parameters that govern them, for conventional fusers.
- Measure image permanence and discuss available steps for improving fusing quality of images on various substrates.

**Intended Audience:** scientists, engineers and technicians who are directly or indirectly involved in the selection, analysis, and evaluation of the numerous fusing technologies used in today’s electrophotographic engines. The course is also beneficial to those working in other areas of EP systems, who wish to have a better understanding of fusing process and materials requirements. A basic understanding of the EP process is assumed; familiarity with the basics of heat transfer and mechanics is beneficial, but not required.

Dinesh Tyagi received his PhD (1985) from Virginia Tech. He then joined Eastman Kodak Company as a research scientist where he specialized in the field of digital printing and polymer research. He was inducted into Kodak’s Distinguished Inventors Gallery in 1994. In 1999, he joined NexPress Solutions (later re-acquired by Kodak). Tyagi currently works at Lexmark International in the area of toners and electrophotography (EP). He has more than 300 patents worldwide. In 2011, he was awarded the Chester F. Carlson Award for his innovations and broad contributions to EP toner technology. In 2014, Tyagi received the Robert F. Reed Technology Medal in recognition for his involvement in graphic communications industry.

**SC12: Digital Packaging**
Monday 13:30 – 15:30 (2 hours)
George Gibson, PARC, Inc., a Xerox Company

The role of the package is becoming increasingly complex and valuable; moving from simply “the thing you put the thing in” to an active part of the pre- and post-sale experience. Beyond simple containment, packages have always had a role in catching the eye of consumers, product protection, and providing basic information, but the bar on those attributes has been raised substantially. Additionally the powerful role the package has been shown to play in improving consumer experience, establishing and protecting brand image, and product protection, has led to the demand for new functionality with some packages even beginning to show up as citizens in the internet of things (some even employing printed electronic components). Packages are becoming part of the overall customer value creation ecosystem.

Smart packaging plays an increasingly important role as the benefits of digital printing and fabrication are being applied to the production of packaging. Conventional package printing techniques certainly
produce the high quality demanded by brand owners but frequently this comes with a lack of flexibility, significant inventory, and waste. Increasingly sophisticated approaches to market segmentation have shown that there is significant value to be had in tailoring offerings to an increasing number of smaller niches. Key to unlocking this potential is the ability to produce packaging of appropriate quality and cost in a way that meets the scale and value chain requirements of the host industry while leveraging the power of digital print to build stronger relationships with their customers, increasing satisfaction, and indeed loyalty from increasingly demanding shoppers.

Packaging is an incredibly diverse domain encompassing metal and glass containers, corrugated, folding cartons, and flexible packaging. Selecting the best digital technique requires a detailed understanding of the printing, the substrates, and the end use requirements. Examining the available digital techniques, this course examines a number of successful implementations and derive heuristics to guide applications. It also explores where additional technological improvements have the greatest leverage.

Benefits
This course enables an attendee to:

- Understand the changing role and requirements placed on packaging in this rapidly changing domain.
- Understand the forces driving adoption of digital print in various package printing applications including the provision of functionality inaccessible to conventional approaches and how these can enable market growth.
- Understand the applications and requirements for package printing in label, folding carton, corrugated, and flexible packaging.
- Map the technology characteristic onto the market requirements identifying the relative strengths, weaknesses, opportunities, and threats of each technology in the context of packaging markets.

Intended Audience: technical professionals who want to become more knowledgeable about how digital printing is likely to fit into the package printing markets.

See bio under SC03: Liquid Toner Printing: Technology and Applications

15:45 – 17:45
SC13: The Development of 3D Printed Functional Medical Phantoms
Monday 15:45 – 17:45 (2 hours)
Instructor: Daniil Nikitichev, University College London

The goal of this class is to learn how develop high-quality, functional 3D prints as anatomical and surgical teaching aids. It is broken into three parts. The first includes a short overview of existing 3D printing technologies. Tips and considerations for preparation of 3D print models are discussed. The second part explains how to load and manipulate 3D medical image data, using simple image processing tools to extract volumes and structures from images, then export those volumes to 3D printing software where they can refine and repair their models. The final part demonstrates how to use 3D printing techniques to develop a set of functional 3D prints for use as anatomical and surgical teaching aids. As an example, rib and kidney models are used.

Benefits
This course enables an attendee to:

- Understand the skills and concepts necessary to create successful 3D prints.
- Learn the main 3D printing techniques and their pros and cons.
- Explain basic image processing and volume extraction techniques (SEG3D, Slicer).
- Summarize the design and material considerations for realistic anatomical models.

Intended Audience: the course is particularly useful to students with engineering or medical backgrounds who have an interest in image processing and 3D printing; technicians and medical professionals who are involved in research activities and require functional realistic models for surgical training and planning; lecturers and those associated with teaching who will benefit from knowing how to create anatomical models using 3D printing.

The first part of the course benefits those who are not familiar with 3D printing. Second and third part of the course is of interest to students and professionals from medical biomedical and engineering backgrounds, who wish to learn basic image processing and volume extraction techniques. The materials make it possible to develop 3D models from medical images that can be used as a learning aid to help visualize anatomy. Moreover, these are of great help to medical and surgical students who need free access to anatomical models, and also to students from associated fields who wish to gain a hands-on understanding of surgical training and planning.

See bio under SC03: Liquid Toner Printing: Technology and Applications

20% SAVINGS
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See registration form for details.
Daniiil Nikitichev earned a PhD from the University of Dundee (2012) in laser physics. The same year he joined the University College London, UK. He is involved both in research and teaching. He is a Fellow of the Higher Education Academy and an Honorary Fellow of the University College London Hospital. His research topics include 3D printing, acoustic properties of 3D printed materials, acoustic sensors, photoacoustic imaging, and optical and photoacoustic phantoms.

SC14: Surface-Ink Interaction and Surface Characterization
Monday 15:45 - 17:45 (2 hours)
Instructor: Emma Talbot, University of Cambridge

Droplets deposited on a substrate can display a wide range of complex phenomena throughout their lifetime. Controlling the particle distribution and micro-structure of the deposit is key to optimizing print quality and functionality. Internal flows within droplets and the interaction of suspended particles (or polymer) with the substrate both influence the deposit structure. This course provides a foundation for how the substrate-ink interaction affects the final deposit, including a detailed overview of the coffee ring effect.

Benefits
This course enables an attendee to:

• Discover how droplet wetting influences the drying lifetime, contact line motion, and internal flows.
• Investigate the role of surface chemistry and droplet coalescence on line stability.
• Understand the coffee ring effect—why it occurs, how to avoid it, when it can be useful.
• Develop knowledge on how ink formulation can be used to control internal flows and deposit structure.
• Consider the dangers of using surface characterization techniques like contact angle measurements on microliter droplets to model picoliter droplets.

Intended Audience: students, scientists, technicians, or anyone interested in learning more about droplet wetting, drying, and deposit structure.

Emma Talbot is a postdoctoral researcher at the University of Cambridge, UK. She received her PhD in chemistry from the University of Durham (2014) on drying inkjet droplets, with a focus on internal flows inside drying inkjet droplets and characterization of the deposit structure. Since 2014 she has been a committee member for the IOP Printing and Graphics Science group. She has served on multiple occasions as a speaker and session chair at previous NIP&DF meetings, and was the Interactive, Print Gallery, and Demonstration Session Chair in 2014.

SC15: Electrophotography & Toner Technology
Monday 15:45 - 17:45 (2 hours)
Instructor: Dinesh Tyagi, Lexmark International, Inc.

Today, laser or LED based printers have become a commonplace object, both at home and at work. Electrophotography (EP) is the underlying print engine technology that is used in printers to create high quality prints in a desktop machine as well as a high productivity digital production press. In the first part of the course, basic steps used in an electrophotographic cycle are briefly described to demonstrate how these fundamental steps control the design of toner based imaging systems. Limitations of each step and technology trends are also explained.

Toners play a very critical role in establishing the value of an electrophotographic print. Since toner comes in physical contact with all critical steps of an EP cycle, its properties not only affect the final printed document but also the life time of components used in other sub-systems. Thus, it is not a surprise that the composition of toner is often determined by the requirements of the finished print as well as the technology selected in other steps of electrophotography. A toner polymers selection is also dictated by the toner manufacturing process used to produce them. The course describes how the toner polymers are selected for both Melt Pulverized Toners (MPT) and Chemically Prepared Toners (CPT). Effect of toner additives, such as, pigments, surface treatment, etc. on fusing and other toner properties are also explained.

The underlying polymer architecture and viscoelasticity concepts that govern toner binders are described and briefly discussed. Polymer models described in this course are equally applicable to polymeric substances used in other parts of the fuser, such as, elastomers and release fluids. Since the toner composition and fusing performance are intricately intertwined, the course describes the influence of toner and the fusing technology employed on the print physical and image permanence. During the course, the selection process for most toner components are described including how these requirements are being continuously guided by environmental, governmental, and health regulations. The course also discuss new developments that are taking place in toners, including, low energy requirements, “green” toners that comprise bio-resins and toner/print recyclability.

20% SAVINGS
Take 3 or more courses and get 20% off your total short course registration fee!
See registration form for details.

Printing for Fabrication 2016
Benefits
This course enables an attendee to:
• Acquire basic understanding of an electrophotographic process and limitations for each sub-system.
• Gain insight into toner component selection and their manufacturing processes along with the impact of each on toner properties, image fixing, and print physicals of a print.
• Understand the polymeric concepts that influence fusing and various considerations necessary in toner formulations.
• Comprehend viscoelastic behavior of toners and polymers. This knowledge can then be used to develop understanding of gloss control and other image requirements.
• Toner components selection criteria would be discussed along with the limitations imposed by toner manufacturing technologies.
• New advances in toners and along with new regulations from various agencies that may impact toners will be described.

Intended Audience: all individuals who are directly or indirectly involved with toner based electrophotographic printing system or those who are engaged in toner formulation development efforts in order to meet wide range of image and toner manufacturing requirements. The course is particularly useful for engineers and scientists who wish to gain insight into how print quality may be controlled via toner component selection and design. A basic understanding of the electrophotographic process will be covered. Many underlying sub-system requirements and limitations, along with polymer concepts will be described in the course.

See bio under SC11: Fusing Physics and Technologies.

SC16: Security Printing Opportunities for the Printing and Fabrication Community
Monday 15:45 – 17:45 (2 hours)
Instructor: Alan Hodgson, Alan Hodgson Consulting Ltd.

This short course highlights the opportunities for the fabrication of printed features in Security Printing. There are specific opportunities in the technologies of physics, chemistry and material science and an ongoing market for new hardware and software applications for print inspection and verification. The course mirrors one given to the security printing community on the threats and opportunities that the technologies presented at this conference bring to secure documents. The benefits that this interaction brings is that the course is tuned to reflect the needs and opportunities for both communities. In particular, there is substantial interest in areas of additive manufacturing and high speed inkjet.

After a brief introduction to this market sector and the technical characteristics of the solutions, the course covers 3 main sections.
• The Security Printing ecosystem— the materials, printing processes, electronics, and electro-optic hardware established in this sector, as well as existing applications and current opportunities.
• The threat from new digital printing technologies. Some of the security features that have been used for years could become compromised by digital printing. These threats are also opportunities for new printed and fabricated security features.
• Emerging opportunities for new features. Printed electronics, mobile imaging, and additive manufacturing are generating significant interest in this sector.

The course features a number of case studies, including:
• The relative attributes of toner and inkjet printing in this space.
• Comparisons of different print-on-paper inkjet solutions. In particular, the effect that high-speed inkjet and page-wide arrays can have on this market.
• Trial examples of additive manufacturing for security printing.

Benefits
This course enables an attendee to:
• Understand the fundamentals driving security printing opportunities.
• Identify opportunities for materials, print engines, and electro-optic hardware.
• Gain an overview of how technologies such as additive manufacturing and mobile imaging can be used in the security print market sector.

Intended Audience: material scientists, print professionals, and engineers looking for applications of their technology in the field of security printing. Join us to explore the opportunities that exist in security printing.

Alan Hodgson has more than 30 years experience in printed hard copy and a background in photography and image science. Hodgson has managed R&D and Technical Services groups active in inkjet application development. He spent 7 years at 3M, specializing in print solutions for high-security documents, i.e., passports and identity cards. He has recently returned to his consultancy business, working on printing projects that include security applications. Hodgson is active in printed electronics, both as a practitioner and Chair of IEC TC 119 (Printed Electronics). He holds a BSc in colortant chemistry and a PhD in instrumentation, both from the University of Manchester. After a 30 year gap he has returned to the university as a Visiting Academic, investigating Printing for Fabrication opportunities for secure documents. He is immediate Past President of IS&T.
Technical and Social Program

All papers are oral unless marked as focal or interactive. Program is subject to change.

See page 5 for details on Monday’s Short Course Program, which runs from 8:00 to 17:45 and offers 16 classes on a wide range of topics.

SPECIAL EVENT: WELCOME RECEPTION
Kick off the conference by meeting friends and colleagues Monday after the Short Courses.
Monday, September 12th
18:00 – 19:30 PM
Manchester Town Hall
Completed in 1877 and regarded as one of the finest examples of Neo-Gothic architecture in the United Kingdom, the Manchester Town Hall is the perfect setting for sharing a drink and some nibbles with colleagues.

SPECIAL EVENT: STUDENT AND YOUNG PROFESSIONALS PUB CRAWL, POOL, AND PING PONG
Students and young professionals: Experience first-hand why the UK is known world-wide for its pub culture and beer! Students from University of Manchester will lead a pub tour of the hip, Northern side of the city. Indicate your interest when you register and we'll send you details closer to the event.
Tuesday, September 13th
beginning at 19:00

Tuesday September 13, 2016

ALL TRACKS
OPENING CEREMONY AND KEYNOTE
9:00 – 10:00
Materials in the Flatland, Kostya Novoselov, University of Manchester (UK)

2016 EXHIBITION
10:00 – 17:45
See inside cover for current list of exhibitors.

STATE-OF-THE-ART KEYNOTE
14:30 – 15:20
HP’s Jet Fusion 3D Printing Technology—Enabling the Next Industrial Revolution, Tim Weber, HP Inc. (USA)

2016 DEMONSTRATION SESSION
16:30 – 17:45
See page 16 for details.

DIGITAL FABRICATION AND 3D PRINTING TRACK
3D PRINTING AND ADDITIVE MANUFACTURING I
10:20 – 16:40
Material Jetting 3D Printing Process by Thermal Inkjet Head, Oh Hyun Bae, Keon Kuk, and Eun-Bong Han, Samsung Electronics Co., Ltd. (Korea)
Finishing Processes of Fused Deposition Modeling (FDM) 3D Printer, Kensuke Takagishi and Shinjiro Umezu, Waseda University and RIKEN (Japan)
Three Dimensional Inkjet Fabrication of Nano-Composite Hydrogel, Yoshihiro Nonikane, Hiroshi Iwata, Takashi Matsumura, Hiroyuki Naitoh, and Tatsuya Niimi, Ricoch Co., Ltd. (Japan)
Newly Developed Printing Technologies for 3D Printed Electronics (Focal), Shizuo Tokito, Yasunori Yoshida, and Konami Izumi, Yamagata University (Japan)
Coated Powder based Additive Manufacturing Using Inkjet Technique, Takafumi Sasaki, Hitoshi lwatsuki, Takeo Yamaguchi, and Daichi Yamaguchi, Ricoch Co., Ltd. (Japan)
Implementation of the Four-Flux Model for Spectral and Color Prediction of 2.5D Prints, Thi phan Van Song, 1,2 Maria V. Ortiz Segovia, 1 and Christine Andraud 2; 1Oce PrintLogic Technologies SA and 2MNHN (France)
Development of Inks Suitable for the Manufacturing of Micro-Scale Polyurethane Foams, Fabian Schuster, 1,2 Tobia Goetz, 1,2 Thomas Hirth, 3 Achim Weber, 1,2 and Monika Bach 1,2; 1Institute of Interface Process Engineering and Plasma Technology, 2Fraunhofer Institute for Interfacial Engineering and Biotechnology, and 3Karlsruhe Institute of Technology (Germany)
On-Demand-Like FDM 3D Printhead Consideration, Hideo Taniguchi, Nobuhisa Ishida, and Jiro Oi, HIT Research Corporation (USA)
3D High Viscosity Jetting of Functional Materials, Javier Ledesma-Fernandez, Christopher Tuck, and Richard Hague, University of Nottingham (UK)
Advancements in Inkjet Technology for Materials Deposition and Manufacturing (Interactive), Scott D. Liniger and William Buskirk, ImTech Technologies LLC (USA)
Depth Feeling Dependence on Array Condition of Objects (Interactive), Yasushi Hoshino, Daiki
OPENING KEYNOTE
Materials in the Flatland
Prof. Kostya Novoselov, Nobel Laureate (2010) Royal Society Research Fellow
School of Physics & Astronomy, University of Manchester

When one writes by a pencil, thin flakes of graphite are left on a surface. Some of them are only one atom thick and can be viewed as individual atomic planes cleaved away from the bulk. Such one atom thick crystals of graphite (dubbed graphene) turned out to be the strongest crystals available to us, the most conductive, most thermally conductive, most elastic, flexible, transparent material, etc., etc., etc. Its electronic properties are particularly exciting: its quasi-particles are governed by the Dirac equation so that charge carriers in graphene mimic relativistic particles with zero rest mass.

Still, probably the most important “property” of graphene is that it has opened a floodgate of experiments on many other 2D atomic crystals: BN, NbSe₂, TaS₂, MoS₂, etc. The resulting pool of 2D crystals is huge, and they cover a massive range of properties: from the most insulating to the most conductive, from the strongest to the softest.

If 2D materials provide a large range of different properties, sandwich structures made up of 2, 3, 4 … different layers of such materials can offer even greater scope. Since these 2D-based heterostructures can be tailored with atomic precision and individual layers of very different character can be combined together, the properties of these structures can be tuned to study novel physical phenomena or to fit an enormous range of possible applications, with the functionality of heterostructure stacks is “embedded” in their design.

STATE-OF-THE-ART KEYNOTE
HP’s Jet Fusion 3D Printing Technology—Enabling the Next Industrial Revolution
Dr. Tim Weber
HP, Global Head, 3-D Materials and Advanced Applications.

In 2014 Hewlett-Packard announced the development and commercialization of an innovative 3D printing technology that promised to set new standards for performance, quality, reliability and low TCO. HP’s Multi Jet Fusion™ (MJF) technology achieves its breakthrough performance by leveraging the company’s 30+ year history of innovation and market leadership in imaging and digital printing. This presentation will provide an introduction to a new-to-the-world digital fabrication technology that makes it possible to design and print three-dimensional objects that possess both precise geometric and functional characteristics. The MJF technology will radically change the way engineers and designers prototype and produce functional parts and the blending of HP’s MJF 3D printing technology with digital materials design creates a new fabrication paradigm—a paradigm that enables innovation in both form and function.

Interpreting the Schedule

By knowing the amount of time allotted for each type of presentation, you can estimate when a particular presentation will occur. Order and times are subject to change; exact times will be published in the conference proceedings. Note there are 30-minute coffee breaks most mornings and afternoons, as well as daily lunch breaks. Presentation lengths include time for Q&A.

Keynote: 50 minutes  Focal: 30 minutes
Oral: 20 minutes  Interactive preview: 5 minutes

MATERIALS, METHODS AND PERFORMANCE TRACK
TONER-BASED PROCESSES
Sponsored by Ricoh Company Ltd.
10:20 – 11:20

RICOH
The Dispersion Control of Crystalline Polyester with Low Melting Point in Amorphous Polyester Toner, Machiko Ie, Norihiro Fukuri, Kohei Katayama, and Eiji Shirai, Kao Corporation (Japan)
Visualization Analysis on Melting Deformation of Toner Particles in a Fusing Nip, Kenichiro Hamada, Minoru Ohshima, Toru Ogawa, and Yoshishika Kitano, Fuji Xerox Co., Ltd. (Japan)
Prediction Technology of Paper Curl in Fusing System, Masato Ando, Tomoyuki Ito, and Takashi Ogino, Fuji Xerox Co., Ltd. (Japan)
Predicting Paper Wrinkles in Fusing Process of Laser Printers Using Dynamic FEA (Interactive), Byoung-Ho Yoo, Je-Hwan You, and Tae-Han Kim, Samsung Electronics Co., Ltd. (Korea)
Preparing Anti-Bacterial Printing Toner via Emulsion Aggregation Method (Interactive), Maryam Ataeefard, Institute for Color Science and Technology (Iran)
METROLOGY TOOLS FOR DIGITAL PRINTING PROCESSES
11:50 – 16:10
Development of a Small Built-in Spectrophotometric Sensor for Color Printers (Focal), Shun-Ichi Ebihara, Masayasu Teramura, Tomohisa Itagaki, and Tatsuya Kobayashi, Canon Inc. (Japan)
Study on Visibility of Density Unevenness in Printed Images Affected by Characteristics in Input Images, Natsumi Minegishi, Konica Minolta, Inc., and Keiji Uchikawa, Tokyo Institute of Technology (Japan)
Effect of Thiourea Compound on Photothermographic Materials based on Silver Benzotriazole (Interactive), Yao Shi and Zhi Li, Chinese Academy of Science (China)
A New Out-of-Gamut Determination Method of Image based on Irregular Segmentation (Interactive), Maohai Lin and Yin Zhang, Qilu University of Technology (China)

DIGITAL PRINTING TECHNOLOGIES TRACK
INKJET-BASED PROCESSES I
Sponsored by Xaar
10:20 – 16:30
Evaluation Method of Inkjet First Drop Dissimilarity, Kye-Si Kwon and Hyung-Seok Kim, Soonchunhyang University (Korea)
Measurement of Inkjet Printhead Reliability by Detecting Every Single Droplet in Flight (Focal), Ingo Reinhold, Tomás Cerný, Maik Müller, and Werner Zapka, Xaar plc (UK)
Titanium Oxoo-alkoxide Clusters as a New Source Material for High Quality TiO2 Structures by Inkjet Printing (Interactive), Josh Turner, Danielle Mehla, Helen C. Aspinall, and Kate Black, University of Liverpool, and Simon Rushworth, EpiValence (UK)
Reproduction of HDR Image on Paper Medium Using Inkjet Printer (Interactive), Xiaozhou Li, Yang Zhao, and Jingqiang Jia, Qilu University of Technology (China)

INVITATION TO SHOWCASE YOUR SOFTWARE AND/OR HARDWARE
Printing for Fabrication Demonstration Session
Technology demonstrations by industry and academic participants showcase the latest developments driving next generation printing products.
This popular event provides authors with an additional opportunity to showcase their work. Authors are offered a complimentary half-table on which to display hardware and/or software related to papers presented at the conference (assuming they register by the Demo Session deadline). Non-authors may take advantage of this opportunity for a small fee that covers expenses.
Indicate your interest in demonstrating when you register for the conference.

INDUSTRY AND ACADEMIC DETERMINATION SESSIONS
Technology demonstrations by industry and academic participants showcase the latest developments driving next generation printing products.
This popular event provides authors with an additional opportunity to showcase their work. Authors are offered a complimentary half-table on which to display hardware and/or software related to papers presented at the conference (assuming they register by the Demo Session deadline). Non-authors may take advantage of this opportunity for a small fee that covers expenses.
Indicate your interest in demonstrating when you register for the conference.
ALL TRACKS

WEDNESDAY KEYNOTE
Low-Temperature Organic and Oxide Transistors for Printable Electronics
Professor Henning Sirringhaus
Hitachi Professor of Electron Device Physics / Head of Microelectronics and Optoelectronics Group / Fellow of Churchill College
Cavendish Laboratory, University of Cambridge (UK)

Over recent years there has been tremendous progress in developing low-temperature processible organic and oxide semiconductors that can be processed by solution-based printing techniques and provide high charge carrier mobilities for both n-type and p-type field-effect transistor operation, good operational stability and other functionalities such as efficient electroluminescence, sensing or memory functions. In this talk I will discuss the basic device and charge transport physics of organic and oxide transistors, review manufacturing approaches and assess their performance in light of a range of applications in displays and integrated systems.

2016 EXHIBITION
10:00 – 16:30
See inside cover for current list of exhibitors.

DIGITAL FABRICATION AND 3D PRINTING TRACK

3D PRINTING AND ADDITIVE MANUFACTURING II
10:10 – 14:50

Fine Particulate and Chemical Emissions from Consumer 3D Printers, Rodney Weber, Qian Zhang, and Jenny Pui Shan Wong, Georgia Institute of Technology; Aika Davis and Marilyn Black, Underwriters Laboratories, Inc. (USA)

Unrestricted 3D Structure Modeling and Seamless Data Flow to 3D Printers Using Voxel-based Data Format FAV (Fab-able Voxel), Tomonari Takahashi, 1 Atsushi Masumori, 2 Masahiko Fujii, 1 and Hiroyuki Tanaka, 2; 1 Fuji Xerox Co., Ltd. and 2 Keio University (Japan)

Polymer Spray Deposition: A Novel Aerosol based Electrostatic Digital Deposition System for Additive Manufacturing, David M. Johnson, Victor Beck, Michael Valente, Armin Volkel, David Biegelsen, Norinne Chang, Cory Lancaster, and Scott Elrod, PARC (USA)

The Impact of 3D Printing on US Copyright and Trademarks (Focal), Scott M. Slomowitz, Gary A. Greene, and Nicholas M. Tinari, Caesor Rivise, PC (USA)

Estimation of High Speed Sintered Nylon-12 Tensile Strength Using Visible Reflectance Spectroscopy, Farhana Norazman and Patrick Smith, University of Sheffield (UK), and Neil Hopkinson, Xaar plc (UK)

The Impact of 3D Printing Technology on Copyright, Hongchen Yang and Fangzhou He, University of China (China)

Spinal Bracing for the Future, Kathryn Downey, Iain Slater, and Brian Derby, University of Manchester, and Abby Paterson, Loughborough University (UK)

PRINTED ELECTRONICS I
14:50 – 17:50

Offset Printing of Conductive Features onto Paper Substrates, Alan Hodgson, Alan Hodgson Consulting Ltd. (UK), and Chris Jones, Novalia Ltd. (UK)

INKJET PRINTABLE ANODE INK FOR FUEL CELL
Applications, Lisa Hakola, Tiina Maaninen, Saara Tuuala, and Anu Vaari, VTT Technical Research Centre of Finland (Finland)

Analysis on Printed Electronics Circuit Design (Interactive), Yingmei Zhou, Shanghai Printing and Publishing College, and Zhongmin Jiang, University of Shanghai for Science and Technology (China)

Fabrication of Printed Switches, Tanja Plea, 1 Matija Mraovi, 2 Uzaka Kavi, 3 Matej Pivar, 1 and Tadeja Muck, 1; 1 University of Ljubljana, 2 Pulp and Paper Institute, and 3 Vulkarton Rakek d.o.o (Slovenia)

A Novel Printable Process for Fabricating Large Size OLED Display, Michel Frantz Molaire and David S. Weiss, Molecular Glasses, Inc. (USA)

Low-Voltage Printable OFETs for Sub-ppm Detection of Ammonia under Humid Conditions, Ehsan Danesh, Sheida Faraji, Daniel J. Tate, Krishna C. Persaud, Leszek A. Majewski, Stephen G. Yeates, and Michael L. Turner, University of Manchester (UK)

INKJET PRINTED POLYESTERYLATES FOR MICROFLUIDIC PAPER-BASED ANALYTICAL DEVICES, Risto Koivunen, 1 Evelinna Jutila, 1 Roger Bollström, 1 and Patrick Garre 1, 2; 1 Aalto University (Finland) and 2 Omya International AG (Switzerland)
MATERIALS, METHODS, AND PERFORMANCE TRACK
PERFORMANCE OF PRINT PRODUCTS
(QUALITY, ROBUSTNESS, PERMANENCE, AND FUNCTIONALITY)
10:10 – 13:00
The Relationship between Dispersion Stability and Print Quality on the Coated Paper, Takayuki Suzuki, Yasufumi Ueda, and Daisuke Hamada, Kao Corporation (Japan)
Visualization and Quantitation Technology of Carbon Black Dispersion State in Intermediate Transfer Belt Using Confocal Laser Scanning Microscope, Ayano Momose, Akira Izutani, and Mitsuhiro Tomoda, Ricoh Co., Ltd. (Japan)
Development of Image Quality and Reliability Enhancing Technology for 29 x 23 Size Digital Inkjet Press KM-1, Toshiyuki Mizutani, Kenichirou Hiramoto, Mitsuru Obata, Toshiyuki Takabayashi, and Tayaaki Sugaya, Konica Minolta, Inc. (Japan)
Motion Illusion Brought by Arrays of Arrowhead Patterns (Interactive), Kazuhiro Otsuki and Makoto Omodani, Tokai University (Japan)
Evaluating Gonio-Appearance in Advanced Printing Materials with Quality Control Procedures and Instrumentation Used for Automotive Coatings (Focal), Bárbara Micó-Vicent, Omar Gómez, Elisabet Chorro, Esther Perales, Valentin Viqueira, and Francisco M. Martínez-Verdú, University of Alicante (Spain)
3D Printed Needle Stylet, Danil I. Nikitchen,1 Simeon J. West,2 and Adrien E. Desjardins1; 1 University College London and 2University College Hospital (UK)
Quantification of Faithful “Color Appearance” Reproduction and Application to New Products, Takumi Kaneko, Katsushi Hara, and Tomokazu Yanai, Canon Inc. (Japan)

PHYSICS AND CHEMISTRY OF MATERIALS I
14:30 – 17:15
Dispersion Control of Liquid Toner by Dispersant and Analysis of Adsorption Status, Tatsuya Yamada, Yoko Hanada, Kousuke Takeda, Nobumichi Kamiyoshi, and Masahito Yamazaki, Kao Corporation (Japan)
Understanding Dynamic Relaxation of Inks at a Timescale Relevant to High Frequency Drop-On-Demand Printing, Nick Jackson, Tri Tuladhar, Maelle Douaire, John Tatam, and Angus Condie, Xaar plc (UK)
High Fixation Reactive Dyes for Digital Textile Printing Application (Interactive), Hsiao-San Chen and Chwan-Shin Lee, Evertlight Chemical Industrial Corporation (Taiwan)
Preparation and Application of Polyurethane Polymer Modified by Nano Silica (Interactive), Qing Wang, Guangxue Chen, Junfai Tian, Minghui He, and Jinglei Tai, South China University of Technology (China)
Shape Control Synthesis of Silver Hierarchical Microcrystals (Interactive), Shidong Nie, Chunyan Liu, and Zhijing Zhang, Chinese Academy of Sciences (China)
Inkjet Printed MoS2 Electronics (Interactive), Keshav Sharma, Pei He, Mark Bissett, and Brian Derby, University of Manchester (UK)
Inkjet Printing with Inks that Phase-Separate during Drying, Ashley S. Johns and Colin. D. Bain, Durham University (UK)
Semi-Conductive Printing Rolls for Improved Print Quality, M.K. Davies and J. Alland, Femmer Precision (USA)
Synthesis of Guar Gum Derivatives in [BMIM]Cl Ionic Liquids and Their Application on Reconstituted Tobacco Sheet (Interactive), Nan Li,1 Wei Chen,2 and Ganguo Chen1; 1South China University of Technology and 2Qufu Normal University (China)

DIGITAL PRINTING TECHNOLOGIES TRACK
INKJET-BASED PROCESSES II
10:10 – 13:10
A Model of Inkjet Process in 3D Printing, Suresh Ahuja, Xerox Corporation (USA)
Key Design Considerations for Measurement of Drops-In-Flight Using Machine Vision, Paul Best, ImageXpert, Inc. (USA)
Inkjet Printing onto Patterned Substrates (Focal), Beth Kazmierka, Colin D. Bain, Lisong Yang, and Emma Talbot, Durham University; Li Wei Tan and Dan Walker, Merck Chemicals (UK)
Refilling Characteristics of High Frequency Piezo Driven Inkjet Print Heads (Focal), J. Frits Dijksman, University of Twente (the Netherlands)
Textile Inkjet Printing to Support US Manufacture Reshoring, Yi Ding, Lisa Parrillo Chapman, and

Manchester is known throughout the UK for its vibrant Chinatown.
THURSDAY KEYNOTE
The Objectives of a National Project of ‘Manufacturing Innovation through Development of Next Generation 3D Printers’ in Japan
Professor Hideki Kyogoku
Faculty of Engineering, Kindai University

Technology Research Association for Future Additive Manufacturing (TRAFAM) was established in 2014 to achieve the development of innovative additive manufacturing systems to meet the world’s highest standards and the development of manufacturing technologies for high value-added products. In this presentation, the current status of the TRAFAM project is introduced.

SPECIAL EVENT: CONFERENCE RECEPTION
Join colleagues for an interesting evening of learning and connecting at MOSI!
Thursday, September 15th
19:00 – 22:00
Manchester Museum of Science and Industry

Flexible Pressure Sensor Driven by All-Printed Optical Waveguides Fabricated by Inkjet and Flexographic Printing
Melinda Hartwig, Markus Gaitzsch, Toni Grossmann, Michael Heinrich, Thomas Gessner, Reinhard Baumann

WORKFLOW
16:30 – 17:15
Optimized White Color Workflow in the Digital Electrophotographic Printing Process
Chunghui Kuo, Eastman Kodak Company (USA)

Development of a Supervision System: Towards Closing the Control Loop in 3D Printing Systems
Alvaro J. Rojas Aracienegas and Juan C. Amaya Hurtado, Universidad Autonoma de Occidente (Colombia)

Functional Coating Developments for the Digital Manufacturing Age (Interactive)
Daniel Loosli and Patrick Le Galudec, Sihl AG (Switzerland)

Thursday September 15, 2016

ALL TRACKS (INCLUDING TDPF)
THURSDAY KEYNOTE AND AWARDS SESSION
9:00 – 10:10
The Objectives of a National Project of ‘Manufacturing Innovation through Development of Next Generation 3D Printers’ in Japan, Hideki Kyogoku, Kindai University (Japan)

INTERACTIVE PAPER (POSTER) SESSION I
11:00 – 12:00

INTERACTIVE PAPER (POSTER) SESSION II
15:30 – 16:30

CONFERENCE RECEPTION
19:00 – 22:00
Manchester Museum of Science and Industry (MOSI)

DIGITAL FABRICATION AND 3D PRINTING TRACK
PRINTED ELECTRONICS II
10:20 – 14:50
Optical Waveguides Fabricated by Inkjet and Flexographic Printing
Patrick Bollgruen, Tim Waßer, Uwe Gleissner, Dario Mager, Christof Megnin, Thomas Hanemann, Ludger Overmeyer, and Jan Korvink
Universität Freiburg, Universitat Hannover, Karlsruhe Institute of Technology (Germany)

JIST-first: Investigation on an Inkjet Printed Passive Sensor for Wireless Ice Detection on Wind Rotor Blades
Melinda Hartwig, Markus Gaitzsch, Toni Grossmann, Michael Heinrich, Lothar Kroll, Thomas Gessner, Reinhard Baumann
Technische Universität Chemnitz and Fraunhofer Institute of Machine Tools and Forming Technology (IVW) (Germany)
ORGANIC TFT ARRAY FILM (Focal), Shinichi Nishi, 1,2
Tohru Miyashita, 1,3 Hiroyuki Endo, 1,4 and Toshihide Kamata 1,5; 1Japan Advanced Printed Electronics Technology Research Association (JAPERA), 2Konica Minolta Inc., 3Dai Nippon Printing Co., Ltd., 4NEC Corporation, and 5The National Institute of Advanced Industrial Science and Technology (AIST) (Japan)

Printability Assessment for Printed Patterns in Printed Electronics Performed by Measuring Geometric Dimensions of Patterns and Defining Assessment Parameters for Printability,
Chung-Hwan Kim, Sung Woong Jeon, and Cheol Kim, Chungnam National University (Korea)

JIST-first: Intense Pulsed Light (IPL) Sintering of an Inkjet Printed Silver Nanoparticle Ink Depending on the Spectral Absorption and Reflection of the Background, Dana Weise, Kalyan Yoti Mitra, Melinda Hartwig, and Reinhard Baumann, Technische Universität Chemnitz (Germany)

The First International Standards for IEC/TC119 Printed Electronics Materials Substrate and Conductive Ink, Masaaki Oda, Satoshi Maeda, Tadanobu Sato, and Chizu Sekine, Japan Advanced Printed Electronics Research Association (Japan)

PRINTED SENSORS
14:50 – 17:10
Digital Design and Fabrication of a Smart Morphing Aerofoil, Peter Walters, Yuying Xia, and Stephen Hoskins, University of the West of England (UK)
Watermarking Embedding Algorithm for Color QR Code based on Image Normalization and Contourlet Transform (Interactive), Qian Guo, Guangxue Chen, and Qifeng Chen, South China University of Technology (China)
A Part Complexity Measurement Method Supporting 3D Printing (Interactive), Luiz Araújo, Ender Özcan, Jason Atkin, and Martin Baumers, University of Nottingham (UK)
Packaging Added Value Solutions by Thermochromic Liquid Crystal-based Printed Labels (Interactive), Maja Jakovljevic and Branka Lazo, University of Zagreb (Croatia), and Marta Kranjsek Gunde, National Institute of Chemistry (Slovenia)

Switchable Passive Wireless Vapour Sensors from Inkjet Printed Electronic Components on Poly(dimethylsiloxane), Kate E. Belsey, 1 Adam V. S. Parry, 2 Christina V. Rumens, 1 Mohammed A. Ziai, 1 Stephen G. Yeates, 2 John C. Batchelor, 1 and Simon J. Holder 1; 1University of Kent and 2University of Manchester (UK)

Inkjet Printed Micro Saddle Coil for MR Imaging, Nan Wang, 1 Aleksandra Egunov, 2 Nilb Spengler, 1 Valerie Luchnikov, 2 Dario Magier, 1 and Jan G. Korvink 1; 1Karlsruhe Institute of Technology (KIT) (Germany) and 2Institute of Material Science of Mulhouse (IS2M) (France)

CONNECTIONS FOR INNOVATION IN SECURITY PRINTING
Thursday, Sept. 15 • 14:30 – 17:30
Moderator: Dr. Mark Deakes, Reconnaissance International (UK)

The aim of this workshop is to connect and build collaborations around new printing technologies for high-value security documents and products. The goal is to bring together a network of participants from industry, government and academia.

After invited short presentations on the topic it is envisaged that group discussion(s) will build on this.

Material presented in the Security Printing Session and Short Course SC16 may be brought into the discussion.

DIGITAL PRINTING APPLICATIONS
10:20 – 10:45
Multicolor Electrochromic Device with LSPR of Silver Electrodeposition Toward Color Reflective Display, Norihisa Kobayashi, Kazuki Nakamura, Jineui Hong, and Riho Tejima, Chiba University (Japan)
The Research of E-book Copyright Protection Methods (Interactive), Fangzhou He and Hongchen Yang, University of China (China)

SECURITY PRINTING
12:00 – 13:20
Security Print Features based on Additive Manufacturing: Threat or Opportunity? (Focal), Alan Hodgson 1,2 and Rachel Saunders 2; 1Alan Hodgson Consulting Ltd. and 2University of Manchester (UK)

Effect of Non-Integer Scaling on the Recovery of Data Bearing Marks, Robert Ulichney, Yufang Sun, and Matthew Goubatz, HP Inc. (USA)
Comparison of Technologies for Card Printing Applications, Mark B. Mizen, HID Global (USA)
Image Scrambling on Packaging Label for Anti-Counterfeiting (Interactive), Phichit Kajondecha and Anan Tanwilaisiri, King Mongkut’s University of Technology Thonburi (Thailand)

Authentication Method for Printed Image Fabrication based on Color Temperature Calculation (Interactive), Sun Peng, National Police University of China (China)
CONNECTIONS FOR INNOVATION IN SECURITY PRINTING WORKSHOP
14:30 – 17:30
See details page 20

BIOPRINTING TRACK
BIOPRINTING I
14:30–17:30

Hydrogel Ink and Biodegradable Paper for Biomedical Applications, Svenja Hinderer,1,2 Sandra Stier,1 Achim Weber,1,3 and Kirsten Barchers1,3; 1Fraunhofer Institute for Interfacial Engineering and Biotechnology IGB, 2Eberhard Karl University, and 3University of Stuttgart (Germany)
Effect of Thermal Inkjet Printing on Bacterial Cells, Cornelius C. Dodoo, Paul Stapleton, and Simon Gaisford, University College London (UK)
Regenerated Bombyx Mori Silk Fibroin as Inkjet Printable Biomaterials, Yu Zhang, David A. Gregory, Patrick J. Smith and Xiubo Zhao, University of Sheffield (UK)
3D Printed Ultrasound Phantoms for Clinical Training (Interactive), James L. Robertson,1 Emma Hill,1 Andrew A. Plumb,1 Simon Choong,2 Simeon J. West,2 and Danill I. Nikitchev1; 1University College London and 2University College Hospital (UK)
Visualization Images of Latent Blood Fingerprints by Ultraviolet Laser (Interactive), Nengbin Cai,1 Xiaochun Huang,1 Liuhu Cui,1 Wenbin Liu,2 Yun Zou,2 and Zhongliang Mi1; 1Institute of Forensic Science and 2Shanghai Research Institute of Criminal Science and Technology (China)
The Use of Inkjet Printing and Thermal Phase Change Inks to Create Sacrificial Prevascular Networks, Leon Edney, Patrick J. Smith, and Paul Hatton, University of Sheffield (UK)

BIOPRINTING II
14:30–17:30

In Vivo Characterization of Bioprinted Capillaries, Maria Yanez, Julio E. Rincon, and Thomas Boland, The University of Texas at El Paso (USA)
Novel Approach for Predicting Coffee-Ring-Effect in Drying Droplets based on Binary Solvent Mixture from Substance Data, Danny Lehmann, Hauke Langner, Vico Haverkamp, and Klaus Krüger, Helmut-Schmidt-University/University of the Federal Armed Forces (Germany)

TOOLS AND STRATEGIES OF PRINT PRESERVATION
15:00 – 17:20

High Speeds, Volker Till, Till GmbH (Germany)
Inks of Organic Cu-Precursors with Short Carbon Chain (Interactive), Wendi Dong Yang, Chunyan Liu, and Zhijing Zhang, Chinese Academy of Sciences (China)
Geometric Element Test Targets (GEITSTM) for Determination of 3D Printers’ Resolutions (Interactive), Shu Chang, Heng Li, and Nathan Ostrout, RIT (USA)
Inkjet Printing and the Steady State Macroscopic Mechanical Energy Balance (SSMMEB) Equation, Steven J. Simske, HP Inc. (USA)
Toner Mask Method for Imaging on Niobium (Interactive), Isao Komatsu and Shuichi Maeda, Tokai University (Japan)
Control of Titania Layer of Dye-Sensitized Solar Cell (DSC) (Interactive), Yuki Nakamura,1 Kengo Takamori,2 Yoshitaka Kunugi, 1 Satoru Iwamori,1 and Shinjiro Umezui2; 1Tokai University and 2Waseda University (Japan)
Elastomer Fatigue in Belt Fusing, David Battat, Lexmark International (USA)
3D Printed Ceramics: Current Challenges and Future Potential, David Huson and Katie Vaughan, University of the West of England (UK)
Simulations of Drop Formation in Complex Rheological Fluids—Can Rheology Improve Jetting Performance?, Oliver G. Harlen and Neil F. Morrison, University of Leeds (UK)

DIGITAL PRINTING TECHNOLOGIES TRACK
PRINTING AND FABRICATION PRINCIPLES AND PROCESSES
10:20 – 14:50

Meniscus Motion Inside a Drop-On-Demand Inkjet Print-Head Nozzle, Claudio Ravasio, Wolfson College Cambridge, Stephen Hoath, University of Cambridge, Marko Dorestijn and Peter Boltynk, Xaar (UK)
Digital UV Printing of 3 Dimensional Objects at High Speeds, Volker Till, Till GmbH (Germany)
Inks of Organic Cu-Precursors with Short Carbon Chain (Interactive), Wendi Dong Yang, Chunyan Liu, and Zhijing Zhang, Chinese Academy of Sciences (China)
Geometric Element Test Targets (GEITSTM) for Determination of 3D Printers’ Resolutions (Interactive), Shu Chang, Heng Li, and Nathan Ostrout, RIT (USA)
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Simulations of Drop Formation in Complex Rheological Fluids—Can Rheology Improve Jetting Performance?, Oliver G. Harlen and Neil F. Morrison, University of Leeds (UK)

TOOL AND STRATEGIES OF PRINT PRESERVATION
15:00 – 17:20

Printing to Preserve: How Are We Doing Today?, Joseph LaBarca, Pixel Preservation International (USA)
Kodak Professional Endura Technology for the Premium Photo Book Market, Patrick W. Webber, Kodak Alaris (USA)
Original Photopaper Developments and Applications to Further the Advancement and Growth of the Premium Photo Book Segment, Anthony Pieters, FUJIFILM Europe B.V. (the Netherlands)

CONFERENCES REGISTRATION + MEMBERSHIP OPTION
Register for the conference and become a member for the same rate as non-member registration.

See details, page 24.
ALL TRACKS (INCLUDING TDPF)  
FINAL KEYNOTE AND CLOSING REMARKS  
9:00 – 10:10  
Title and Speaker TBA (Topic: Bioprinting)  

TECHNOLOGY TOURS  
15:30 – 17:30  
See page 23 for details.  

MATERIALS, METHODS, AND PERFORMANCE TRACK  
PHYSICS AND CHEMISTRY OF MATERIALS  
10:10 – 12:50  
Hi Resolution Inkjet Printing of OLEDs at Merck, Daniel Walker, Merck (UK)  
Fully Solution Processed Light-Emitting Electrochemical Cells (OLEC) with ZnO Interlayer for Lab-on-Chip Applications, Zhe Shu, 1,2 Erik Beckert, 2 Ramona Eberhardt, 2 and Andreas Tuennermann 1,2; 1 Friedrich Schiller University Jena, and 2 Fraunhofer Institute for Applied Optics and Precision Engineering IOF (Germany)  
Application of Vinylcarbonates as Low-Toxic Monomers in Digital Inkjet Inks, Matthias Edler, 1 Florian H. Mostegel, 1 Meinhart Roth, 1 Andreas Oesterreicher, 1 Richard Piocck, 2 and Thomas Griesser 1; 1 Montanuniversitaet Leoben and 2 Durst Phototechnik DITGmbH (Austria)  
Sub-Micron Patterning of Polymer Brushes by Controllable Deposition of Polyelectrolyte Mono-layers (Focal), Adam V. S. Parry, 1 Alexander J. Straub, 1, 2 Lianne M. Jordan, 1 Stephen G. Yeates, 1 and Steve Edmondson 1; 1 University of Manchester (UK) and 2 Universitat Freiburg (Germany)  
Multi-Functional Carbon Fibre Composites Obtained Using Inkjet Printed Polymers (Focal), Patrick J. Smith and Yi Zhang, University of Sheffield (UK)  
Liquid Exfoliation of Layered Material in Water for Inkjet Printing, Viviane Forsberg, Renyun Zhang, Henrik Andersen, Joakim Backstrom, Christina Dahlstrom, Britta Anders, Magnus Norgen, and Hankan Olin, Mid Sweden University (Sweden)  

LASER IMAGING AND PATTERNING  
14:20 – 15:10  
Development for Secondary Color Graininess Separation Method for the Electrophotographic Imaging (Focal), Yumiko Kishi, Kazuki Funahashi, and Makoto Hino, Ricoh Co., Ltd. (Japan)  

Laser Color Marking Using Thermo-Sensitive Recording Paper, Nobuki Namoto, Fumitoshi Morimoto, Yoko Tada, Kengo Wakamatsu, and Yoshihito Ishikawa, Toshiba Corp., and Ryoichi Umezawa, Nidec Copal Corp. (Japan)  

BIOPRINTING TRACK  
BIOPRINTING II  
10:10 – 13:00  
Fabrication of ZrO2-SiO2 Binary Oxides Scaffold by Inkjet Printing for Bone Tissue Engineering Applications, Vasanthavel Subramanian, Brian Derby, and Kannan Sanjeevi, University of Manchester (UK)  
Placenta Vasculature 3D Printed Imaging and Teaching Phantoms, D. I. Nikitchev, 1 W. Xia, 1 B. Daher, 1 E. Hill, 1 R. Y. J. Wong, 1 A. L. David, 2 A. E. Desjardins, 1 S. Ourselin, 1 and T. Vercauteren 1; 1 University College London and 2 University College Hospital (UK)  
Printed Electronics and 3D Printing as New Manufacturing Technologies: New Opportunities for Biomaterials, Tingjie Li, Joseph Aspler, Arlene Kingsland, Lynne M. Carmier, and Xuejun Zou, FFilnovations (Canada)  
Reactive Inkjet Printing Applications for Tissue Engineering (Focal), Christopher Tse and Patrick Smith, University of Sheffield (UK)  
Growth-Inhibitory Effect of Chemotherapeutic Drugs Dispensed by Inkjet Bioprinting on Cancer and Non-Cancer Cells, Jorge Rodriguez-Devora, Clemson University, and Mohammad Bhiyan, Daniel Reyna-Soriano, and Thomas Boland, University of Texas at El Paso (USA)  
Reactive Inkjet Printing of Biocompatible Silk Micro-Rockets (Focal), David A. Gregory, Yu Zhang, Patrick J. Smith, Xiubo Zhao, and Stephen J. Ebbens, University of Sheffield (UK)  

DIGITAL PRINTING TECHNOLOGIES TRACK  
INK SUBSTRATE INTERACTIONS  
14:00 – 15:00  
The Effect of Nanoparticle Binders and Modified Precipitated Calcium Carbonate on Ink Absorption Behavior in a Multilayered Coating Layer, Katrina Mielenon, Teija Laukala, and Kai Backfoll, Lappeenranta University of Technology (Finland)  
Inkjet Alchemy - Inkjet Printing of Thin Metal Oxide Films with Dichroic and Metallic Appearance, Wladek Kasperchik, Vladimir Jakubek, and Jay C. Bhatt, HP Inc. (USA)  
Controlling Coffee Staining Effect of Inkjet Printed Droplets from Graphene Oxide Inks, Pei He and Brian Derby, University of Manchester (UK)
PHOTO BOOK CONSTRUCTION AND PRESERVATION
10:10 – 12:10
Long-Term Digital Preservation of Photo Books, Mark B. Mizen, All About Images (USA)
Using Technology to Acquire Customers in the Personalised Photo Market, Dianne Maralee, Taopix Limited (UK)
Customer Photo Books for the Future, Brigitte Vantieghem, Peleman Industries, Inc. (USA)

FACTORS THAT INFLUENCE PERMANENCE AND DURABILITY OF PHOTO BOOKS
12:30 – 15:00
Safety of Freezing Inkjet Prints for Long Term Storage, Ivey Barker and Daniel Burge, Image Permanence Institute (USA)
Photo Book Permanence and Durability Standards and Their Impact on the Fulfillment Industry, Stuart T. Gordon, Kodak Alaris (USA)
A Guide for the Assessment and Mitigation of Bleed, Gloss Change, and Mold in Inkjet Prints During High-Humidity Conditions, Jennifer Burger, University of Rochester, and Daniel Burge, Image Permanence Institute (USA)

TECHNOLOGY TOURS
Friday, September 16
~15:30 to ~17:00
A chance to see some of the facilities on the University campus and an opportunity to discuss potential collaborations with researchers. Tours last approximately 60-90 minutes. Details on where to meet will be provided closer to the event.

Register for a tour when you register for the conference. See registration form, pages 24-25. Tour attendance will be confirmed closer to the event. You will be contacted if we are in an “over sold” situation.

Graphene: The UK National Graphene Institute was opened in 2015 and is situated a 10-15 minute walk from the Renold Building. The tour will give an overview of the state-of-the-art clean-rooms plus, the laser, optical, metrology, and chemical labs and equipment.

Printing: Take a walking tour of The University of Manchester Centre for Digital Fabrication. The tour visits the fabrication, bioprinting and inkjet printing laboratories, located across the campus. Current and past projects will be illustrated.

Characterization: Tour the Photon Science Institute. Take a look at the materials characterization facilities with ultrafast laser and tomography systems.

Textiles: Building on the history of the University in textile science, visit the faculties dedicated to functional textiles. See where screen printing could take us for the fabrication of the next generation of textile based features.

Preservation: Housed in a late-Victorian neo-Gothic building, the John Rylands Library houses one of the UK’s largest special collections. Participants in this tour see the library’s photo and heritage imaging collection. The Rylands Library is located about a 20-25 minute walk from the Renold Building, in the heart of the city by Town Hall.

The British are known for their beautiful gardens, and Manchester takes full advantage of local green thumbs.
PRINTING FOR FABRICATION 2016 REGISTRATION

Register online at www.imaging.org/manchester

First/Given Name__________________________________________________________________________

Last/Family Name _________________________________________________________________________

Title/Position______________________________________________________________________________

Company _________________________________________________________________________________

Complete Mailing Address ___________________________________________________________________

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Telephone__________________________________________Fax _________________________________

Email____________________________________________________________________________________

Conference registration includes: admission to all technical sessions, including the Technologies in Digital Photo Fulfillment program; proceedings abstract book + full papers on USB flash drive; entrance to the exhibit; coffee breaks; the Welcome and Conference Receptions; and a tour (based on availability). Separate registration fees are required for short courses.

Print Gallery and Demonstration Session (see page 16 for details)

☒ I would like to reserve a 2’ x 4’ space for a print gallery sample.*

☒ I would like a half-table to demonstrate a program/product related to the talk I am giving.*

(Session and Paper Title): __________________________________________

☒ I am not an author, but would like information on reserving space to demonstrate a program/product*

Conference Registration (CHECK ONE)

Please check ALL that apply. I am a:

☒ speaker ☒ session chair ☒ committee member ☒ IS&T member ☒ ISJ member

Please note: To better serve your needs, IS&T is offering conference registration options that include membership for the same price as a non-member fee. If you select a registration category with membership, please also choose between an online subscription to the Journal of Imaging Science and Technology (JIST) or Journal of Electronic Imaging (JEI).

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<td>Conference registration: current IS&amp;T/ISJ Member</td>
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<td>Technologies in Digital Photo Fulfillment ONLY</td>
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* You will be contacted by IS&T staff with further details.

** If you choose this option, you may register for Short Courses at the Member rate.

Extra Procedings

Registration includes proceedings abstract book + full papers on USB flash drive.

Hardcopy proceedings book (full papers) _______ @$125/each $_____

Extra abstract book + USB flash drive _______ @$1.50/each $_____

Extra USB flash drive _______ @$100/each $_____

Registration Subtotal $_____

Extra Proceedings

Page Subtotal $_____

continued on next page
PRINTING FOR FABRICATION 2016 REGISTRATION CONT’D.

We recognize that changes in the imaging industry have put some of our loyal attendees in strained financial situations. If you are currently unemployed, but would still like to attend this year’s meeting, please contact dsmith@imaging.org to discuss your situation.

<table>
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<tr>
<th>Short Course Registration (see page 5 for course descriptions)</th>
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OR

Take three or more classes and receive 20% off the total price

(enter three or more two-hour courses, fill in member or non-member fee next to each, add together, and multiply by .80 to get your price, representing 20% savings; add additional lines if needed; students may not take advantage of this offer)

\[ T_{\text{sum}} = \sum T_{\text{class}} \times 0.80 \]

Student and Young Professional Event (see pages 3 and 14 for details)

- I would like to take part in the Student and Young Professional Pub Crawl, Ping Pong, and Pool. (You will be contacted with details closer to the event.)

Tours (see pages 4 and 23 for details)

- I would like to take part in the following Friday afternoon tour (select one). First-come/first-served policy applies.
  - National Graphene Institute
  - The Centre for Digital Fabrication
  - Rylands Library
  - Textile Science & Technology
  - Photon Science Institute (4D Imaging Centre)

Extra tickets for guest/spouse for receptions

- Extra Welcome Reception Ticket (Name: ______________________) $55 $____
- Extra Conference Reception Ticket (Name: ______________________) $75 $____

Membership (see also conference reg options)

<table>
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<tr>
<th>US Address</th>
<th>Non-US Address</th>
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<tr>
<td>$145</td>
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<td>$105</td>
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For all memberships select one: JIST online or JEI online

Join now and calculate fees based on member rates

Subtotal from previous page $____

Wire transfer fee, if applicable ($25) $____

GRAND TOTAL $____

Payment Method: AmEx MasterCard VISA Discover Wire Transfer Check

Card#: ______________________ Exp. Date: ____________

Name as it appears on card: ______________________

Authorization Signature: ______________________

Return this form with signed credit card authorization to IS&T, 7003 Kilworth Lane, Springfield, VA 22151 or fax to +1 703 642 9094. We do not encourage sending via email.

Contact registration@imaging.org for wire transfer information.

Note, $25 must be added to the Grand Total for wire transfer payments to cover bank costs.

Please note: To cover bank charges and processing fees, there is a cancellation fee of $75 until September 6, 2016. After that date, the cancellation fee is 50% of the total plus $75.

No refunds will be given after September 30, 2016. All requests for refund must be made in writing.