

University College Dublin

PRN 2019

9th~10th, May, 2019

Venue:

326, Material Science and Engineering Centre, School of Mechanical and Materials Engineering, University College Dublin, Belfield, Dublin 4, Ireland

The Polymer Replication on Nanoscale (PRN) conference series has been held previously in Denmark, Switzerland and Germany and is established as an important international forum for leading experts to exchange latest

developments, research findings and future vision for polymer micro/nano manufacturing and its applications.

It is our great pleasure to invite you to the 6th

International PRN Conference, to be held in Dublin organised by the UCD Centre of Micro/ Nano Manufacturing Technology (MNMT-Dublin) and co-organised by the International Society for Nanomanufacturing.

PRN2019 PROGRAM

9-10 May, 2019

Venue:

326, UCD Material Science and Engineering Center
School of Mechanical & Materials Engineering
University College Dublin
Belfield, Dublin4
Ireland

Thursday 9 May 2019, PRN 2019 Conference

Time	Events	Page
12:30-12:50	Registration and Reception (in front of room 326)	
Session 1: Micro/Nano Manufacturing I (12:50-14:50)		
Chair: Nan Zhang (UCD, Ireland)		
12:50-13:00	Nan Zhang (MNMT-UCD, Ireland) <i>Welcome to the Polymer Replication on Nanoscale 2019</i>	
13:00-13:30	Invited: Fengzhou Fang (UCD, Ireland) <i>Micro/nano fabrication for applications in optical and bio-medical engineering</i>	15
13:30-14:00	Invited: Jens Ducree (FPC-DCU, Ireland) <i>Efficient development of commercially viable Lab-on-a-Chip solutions by a platform-based design-for-manufacture strategy</i>	16
14:00-14:30	Industry highlight: Jonathan Geukes (temicon, Germany) <i>Polymer microreplication: from flat to freeform surfaces</i>	25
14:30-14:50	Dario Loaldi (DTU, Denmark) <i>Injection moulding optimization of nanostructured components using surface fingerprint</i>	26
14:50-15:20	<i>Coffee Break and Poster Session</i>	

Session 2: Micro/Nano Replication (15:20-18:00)

Chair: Michael Gilchrist (UCD, Ireland)

Time	Events	Page
15:20-15:50	Invited: Helmut Schiff (PSI, Switzerland) <i>Nanoreplication: An enabling technique from micro-optics to printed electronics</i>	17
15:50-16:20	Invited: Per Magnus Kristiansen (FHNW, Switzerland) <i>Same but different - unconventional routes towards functional surface topographies</i>	18
16:20-16:40	Rafael Taboryski (DTU, Denmark) <i>Polymer replication of self-assembled nanosurface</i>	27
16:40-17:00	Ilja. Czolkos (NILT, Denmark) <i>Replication of advanced optical structures</i>	28
17:00-17:20	Gareth Redmond (UCD, Ireland) <i>One-dimensional polymer nanostructures by alumina pore template replication: monitoring & control of chain organization in polyfluorenes for device functionality</i>	29
17:20-17:40	Nan Zhang (UCD, Ireland) <i>Precision replication of micro lenses arrays using variotherm and in-mould micro compression assisted injection moulding</i>	30
17:40-18:00	Ritika Singh Peteresen (DTU, Denmark) <i>Hot punching: A versatile tool to fabricate microparticles</i>	31
18:00-18:30	Networking & Poster Session	
18:30	Coach transfer to conference dinner (Fern House Restaurant, Avoca)	
19:00-22:00	Reception & Conference Dinner (return by coach afterwards)	

Friday 10 May 2019, PRN 2019 Conference

Session 3: Additive Manufacturing (9:00-10:50)

Chair: Xichun Luo (University of Strathclyde, UK)

Time	Events	Page
09:00-09:30	Invited: Shoufeng Yang (KUL, Belgium) <i>The next generation of Additive Manufacturing: Multiple materials</i>	19
09:30-09:50	Andy Gleadall (Loughborough University, UK) <i>Simulation of microscale geometry in extrusion-based additive manufacturing</i>	32
09:50-10:10	Hossam Ibrahim (UCD, Ireland) <i>MATRIXASSAY – Novel tissue and cell migration assay</i>	33
10:10-10:30	John T. Sheridan (UCD, Ireland) <i>Photopolymer Recording Materials</i>	34
10:30-10:50	Colm Delaney (UCD, Ireland) <i>2-Photon polymerisation for the generation of versatile replica moulding masters</i>	35
10:50-11:20	<i>Coffee Break and Poster Session</i>	

Session 4: Micro/Nano Manufacturing II (11:20-13:00)

Chair: Per Magnus Kristiansen (INKA FHNW, Switzerland)

Time	Events	Page
11:20-11:50	Invited: Michael Gilchrist (UCD, Ireland) <i>Manufacturing polymeric micro/nano devices: from tooling to precision replication</i>	20
11:50-12:20	Invited: Xichun Luo (University of Strathclyde, UK) <i>Laser processing techniques for precision mould and die</i>	21
12:20-12:40	Tomas Baldi (Universitat Ramon Llull, Spain) <i>Laser texturing of plastic injection moulding for optical properties</i>	36
12:40-13:00	Maria Angione (ADAMA, Ireland) <i>High performance DLC-based mold technology with high control over micro and nano features for optics and microfluidics</i>	37
13:00-14:00	Lunch in UCD University Club	

Session 5: Applications (14:00-16:20)

Chair: Rafael Taborisky (DTU, Denmark)

Time	Events	Page
14:00-14:30	Invited: Dmitry Kashanin (Cellix, Ireland) <i>Microfluidic biochips for applications in high throughput cell analysis and related microfabrication methods</i>	22
14:30-15:00	Invited: Conor O'Mahony (Tyndall-UCC, Ireland) <i>Development and industrialisation of polymeric microneedle technologies for transdermal sensing and diagnostics</i>	23
15:00-15:20	Damien King (FPC-DCU, Ireland) <i>Pilot scale production of process analytical technology microfluidic devices</i>	38
15:20-15:40	Jing Lyu (UCD, Ireland) <i>Fabrication of hyperbranched PEG polymers with multiple functional groups: a promising class of materials in micro/nano manufacturing</i>	39
15:40-16:00	Zarmeena Abid (DTU, Denmark) <i>Biodegradable microcontainers on a water-soluble substrate fabricated by hot punching for oral drug delivery</i>	40
16:00-16:20	Riley Gatensby (TCD, Ireland) <i>Plasma etching of high molecular weight block copolymer patterns into glass for optical applications</i>	41
16:20-16:25	Close of PRN2019 and announcement of PRN 2020	

POSTER PRESENTATIONS

Poster Session: (18:00-18:30, 9th of May; and 13:00-14:00, 10th of May)

Name	Page
<p>J. Werder (FHNW, Switzerland) <i>Speeding up the development of injection molded thermoplastic microfluidic devices by polymeric prototype mold inserts</i></p>	43
<p>Hossam Ibrahim (UCD, Ireland) <i>Moulded collagen films for multiscale mechanical testing</i></p>	44
<p>J. Allum (Loughborough University, UK) <i>Microscale Control in Material Extrusion Additive Manufacturing</i></p>	45
<p>Majid Fazeli Jadidi (TCD, Ireland) <i>Micro-patterned features for injection molding process and its optical quality control</i></p>	46
<p>Paven Thomas Mathew (UCD, Ireland) <i>Periodic energy decomposition analysis for the application of electronic transport across a molecular junction</i></p>	47
<p>Honggang Zhang (UCD, Ireland) <i>Development of high hardness, self-lubrication nickel/graphene oxide composite coating using ultrasonic assisted electrodeposition</i></p>	48
<p>J.A. Smith (Loughborough University, UK) <i>Development of novel functionally graded polymer composites for biomedical additive manufacture</i></p>	49
<p>Andrea Bocchino (Tyndall National Institute, Ireland) <i>A scalable, double-sided micromoulding process with enhanced electrical functionality for microneedle-based diagnostics</i></p>	50

Scope of the Conference:

The conference will address issues in large scale replication of micro- and nanostructures in polymer materials including:

- Manufacturing of structured moulds, inserts or shims for polymer replication
- Industrial replication technologies, injection moulding, roll-to-roll techniques and other innovative processes
- Materials for replication of polymer micro- and nanostructures
- Applications for functional micro- and nanostructured polymer surfaces
- Metrology and characterisation of micro- and nanostructured polymer surfaces
- Simulation and computing of different phenomena for micro- and nanoscale replication

Local Organising Committee:

MNMT-Dublin & UCD Engineering

- Nan Zhang
- Michael Gilchrist
- Fengzhou Fang
- Jinghang Liu

UCD Chemistry

- Gareth Redmond

Conference Sponsors:

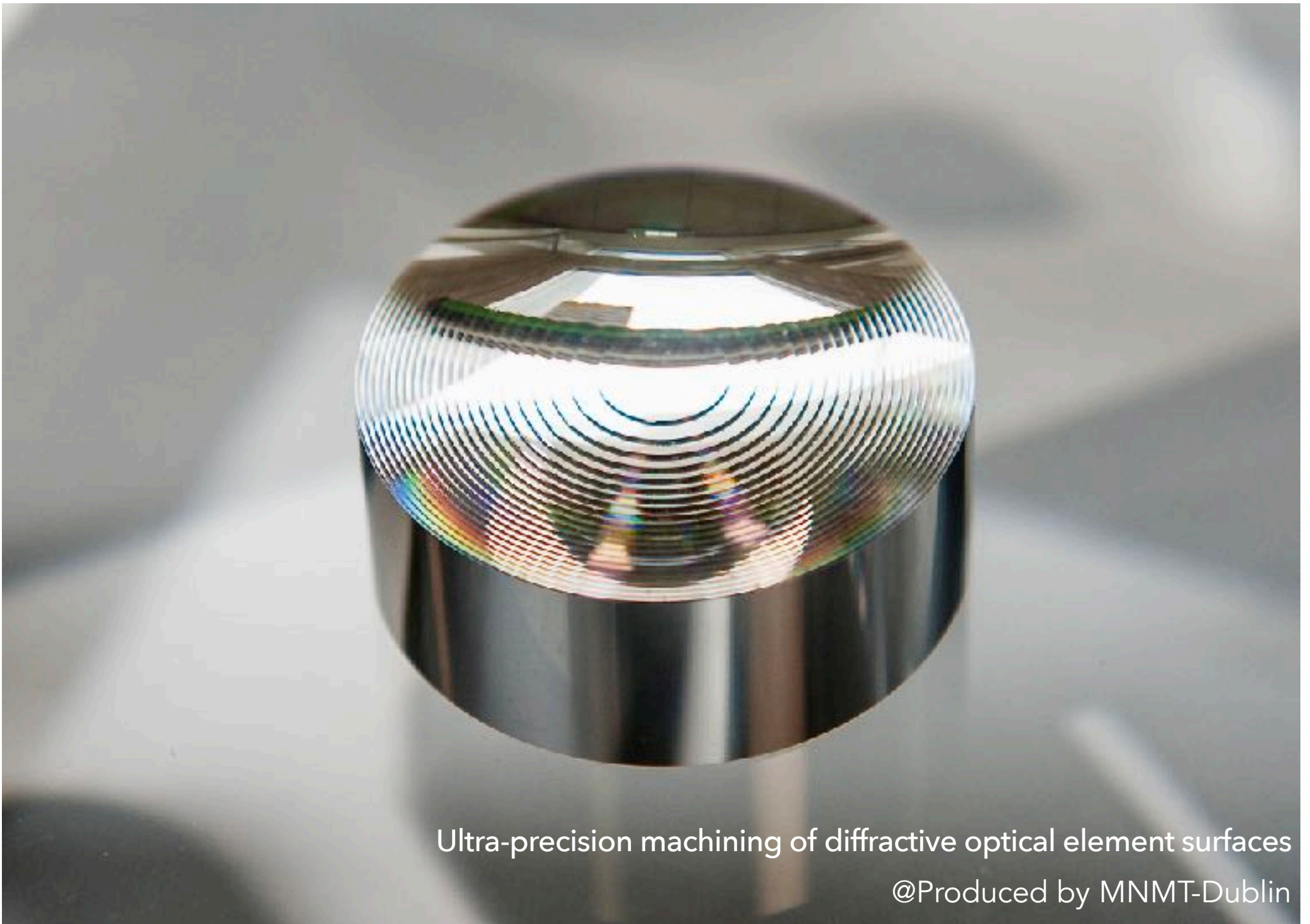


**Bertram Broberg
Foundation**



Conference Exhibitors:





Ultra-precision machining of diffractive optical element surfaces
@Produced by MNMT-Dublin



Microinjection moulded plastic microfluidic chip
@Produced by MNMT-Dublin

WELCOME



Dr Nan Zhang

Welcome to the PRN2019

On behalf of the organising committee, I sincerely welcome you to University College Dublin for the 6th International PRN Conference.

It is my pleasure to host PRN 2019 at UCD by gathering world leading experts in the area of ultra-precision/precision machining, micro/nano replication and applications that pertain to microfluidics, optics and medical devices. Ireland is one of Europe's largest MedTech hotspots and, as a globally recognised centre of excellence, is home to 300+ companies, employing 32,000 people. Nine of the world's top ten medical device companies have manufacturing operations here. As polymer materials are important for medical device manufacturing, there are more than 230 polymer companies in Ireland with employing 7,000 people and with exports valued at €1.62 billion annually. However, most of these companies focus on large-scale product manufacturing. Polymer micro/nano manufacturing has been used in many fields including medical technology, automotive technology, life science and optical industry. Future developments will include developing freeform large-area micro/nano structures for innovative applications. It is our wish that this conference will trigger innovation and encourage new connections between our participants.

PRN 2019 has an exciting programme in which you will hear about state-of-the-art technologies in fabricating ultra-precision and precision moulds, micro/nano replication using nano imprinting and injection moulding, micro/nano additive manufacturing, and applications in areas of microfluidics, optics and biomedical devices. The coming two days will present a strong programme of 9 invited talks, 14 oral presentations some industrial exhibitions, and an attractive poster session.

We wish that you enjoy the conference and find it fruitful for your network and development.

Thank you for coming and enjoy!
Nan Zhang

INVITED SPEAKERS

Prof. Fengzhou Fang, Centre of Micro/Nano Manufacturing Technology (MNMT-Dublin), University College Dublin, Ireland

“Micro/nano fabrication for the applications in optical and bio-medical engineering”

Biography:

Professor Fengzhou Fang has over 30 years of experience in manufacturing science and technology, with a particular specialisation on industrially relevant topics that include optical freeform design and manufacturing, micro/nano manufacturing, medical devices/implants manufacturing, ultra-precision manufacturing, and metrology. These areas are relevant to aspheric and freeform optical systems, medical devices, bio-medical implants, visual optics and engineering components. Prof Fang has worked with over 100 industrial partners, assisting these companies to develop their R&D activities. He has published over 200 papers in peer reviewed journals, along with 12 book chapters, and over 50 patents. He is the Founding President of the International Society for Nanomanufacturing (ISNM) and the editor-in-chief of Nanomanufacturing and Metrology (N&M). He is a Fellow of ISNM, a Fellow of the International Academy for Production Engineering (CIRP), and a Fellow of the Society of Manufacturing Engineers (SME).



Prof. Jens Ducree, Microsystems in the School of Physical Sciences at Dublin City University (DCU), Fraunhofer Project Centre for Embedded Bioanalytical Systems at DCU (FPC@DCU), Ireland

“Efficient development of commercially viable Lab-on-a-Chip solutions by a platform-based design-for-manufacture strategy”

Biography:

Dr. Jens Ducree holds a Full Professorship of Microsystems in the School of Physical Sciences at Dublin City University (DCU). He is the founding director of Ireland's first Fraunhofer Project Centre for Embedded Bioanalytical Systems at DCU (FPC@DCU) – a joint initiative of Science Foundation Ireland and Fraunhofer-Gesellschaft. Dr. Ducree is also academic member of the National Centre for Sensor Research (NCSR) and the 3U Joint Institute of Global Health (JIGH), and a principal investigator for Microfluidic Platforms at the Biomedical Diagnostics Institute (BDI) since 2008.

The main part of his research is directed towards novel microfluidic systems and associated actuation, detection, fabrication and instrumentation technologies for the integration, automation, miniaturization and parallelization of sample preparation and detection of bioanalytical assays (e.g. immunoassays, nucleic acid testing, general chemistry and cell counting). Typical applications of these next-generation “Lab-on-a-Chip” platforms are sample-to-answer systems for biomedical point-of-care and global diagnostics, liquid handling automation for the life sciences (e.g. concentration / purification and amplification of DNA / RNA from a range of biosamples), process analytical techniques and cell line development for biopharma as well as monitoring the environment, infrastructure, industrial processes and agrifood.



INVITED SPEAKERS

Dr Helmut Schift, Paul Scherrer Institut (PSI), Laboratory for Micro- and Nanotechnology, 5232 Villigen PSI, Switzerland

“Nanoreplication: An enabling technique from micro-optics to printed electronics”

Biography:

Helmut Schift studied electrical engineering at University of Karlsruhe, Germany, and the École Nationale Supérieure de Physique de Strasbourg, France, and performed his Ph.D. studies at the Institute of Microtechnology Mainz, Germany. After his graduation in 1994, he joined the Paul Scherrer Institut (PSI) in Villigen, Switzerland as a research staff member, where he heads the Polymer Nanotechnology Group in the Laboratory for Micro- and Nanotechnology. Since more than 20 years he is involved in the development of nanoimprint lithography (NIL) as an alternative nanopatterning method and has worked in national and international projects and on a range of applications. In 2015, during the celebration of 20 years of Nanoimprint Lithography, he was awarded the Nanoimprint Pioneer Award.



Prof. Shunyao Yang, KU Leuven, Belgium

“The next generation of Additive Manufacturing: Multiple materials”

Biography:

Shoufeng Yang is a Full Professor in KU Leuven, Belgium, and a Chair Professor at the University of Southampton, UK, where he is leading Additive Manufacturing research activities. His main research interests are the next generation of additive manufacturing, in which both the materials composition and the shape of objects are computer controlled throughout three dimensional space. He has published more than 110 papers and is a top cited researcher in Additive Manufacturing/Rapid Prototyping/3D Printing in Google Scholar with H-index 31 and total citations >5900. His single paper citation is >2900. A few of his papers have been listed as 1% Highly Cited Paper by Essential Science IndicatorsSM. He has pioneered the development and application of a novel dry powder dispensing technology for multiple materials additive manufacturing (MMAM). Wide range of materials can be dispensed including metal, polymer and ceramic. This project was selected for prestigious Royal Society Summer Science Exhibition (royalsociety.org/From-music-to-sand-painting/). He is also a Visiting Professor in the NTU Additive Manufacturing Centre in Nanyang Technological University Singapore. He is on the Editorial Board of 8 international journals including Virtual and Physical Prototyping, as well as being a founding member of the International Journal of Bioprinting Associate Editor of the Journal of 3D Printing in Medicine.



INVITED SPEAKERS

Prof. Dr. Per Magnus Kristiansen, FHNW University of Applied Sciences and Arts, Northwestern Switzerland, School of Engineering, Institute of Polymer Nanotechnology (INKA), Switzerland

“Same but different - unconventional routes towards functional surface topographies”

Biography:

Prof. Dr. Per Magnus Kristiansen is head of the Institute of Polymer Nanotechnology (INKA), jointly operated by the FHNW University of Applied Sciences and Arts Northwestern Switzerland and the Paul Scherrer Institute. He studied Materials Sciences and earned his PhD in Polymer Technology at ETH Zürich. In 2004, he joined Ciba Specialty Chemicals working on plastic additives for packaging and automotive. Since 2009, he is Professor in Polymer Nanotechnology at FHNW. His applied research focuses on high-fidelity surface structuring of polymers on the micro- and nanoscale, with particular emphasis on industrial replication technologies for applications in the fields of microfluidics and micro-optics. Prof. Kristiansen is author/co-author of 23 peer-reviewed papers and 7 patent families, member of several advisory boards and the executive committee of the Swiss Nanoscience Institute.



Prof. Michael Gilchrist, School of Mechanical and Materials Engineering, University College Dublin, Ireland

“Manufacturing polymeric micro/nano devices: from tooling to precision replication”

Biography:

Michael Gilchrist, PhD, DEng, FIMechE, FIEI, FIMMM, FInstP, FISNM, is Full Professor of Mechanical Engineering. His research concerns the precision processing of polymeric materials for mass manufacturing applications. This is particularly focussed on injection moulding and complementary processes. He is also interested in the mechanical response of soft biological tissue to impact and dynamic loading conditions. Two of his former students have established start-up technology companies (in USA and Canada). He holds a Visiting Professorship at the University of Ottawa and has previously been a Visiting Professor at CNRS & ENSAM-Paris. He has supervised 40 researchers at Masters, Doctoral and Postdoctoral levels and has published some 180 journal articles. He is Ireland's representative to IUTAM, the International Union for Theoretical & Applied Mechanics.



INVITED SPEAKERS

Dmitry Kashanin, Cellix Limited, Dublin, Ireland

“Microfluidic biochips for applications in high throughput cell analysis and related microfabrication methods”

Biography:

Dmitry has an M.Sc. in Computer Science and Electronics from Novosibirsk State University and an M.Sc. in Physics from Trinity College Dublin, where his work resulted in the spin-out of Cellix. He is CTO & Co-Founder of Cellix. He has over 20 years of expertise in the areas of microfluidics, microelectromechanical systems (MEMS), fluid dynamics, laboratory automation tools and plastic manufacturing techniques. With a primary degree in computer science, he also has excellent technical knowledge of digital signal processing, embedded real-time data acquisition systems, hardware interfacing, software programming and development, image acquisition and processing.



Prof. Xichun Luo, Centre for Precision Manufacturing, University of Strathclyde, UK

“Laser processing techniques for precision mould and die”

Biography:

Xichun Luo is a Professor in ultra precision manufacturing and Technical Director of the Centre for Precision Manufacturing (CPM) at the University of Strathclyde (Glasgow). He is a Fellow of the International Society for Nanomanufacturing and an editor for Proceedings of IMechE Part C: Journal of Mechanical Engineering Science, Journal of Micromanufacturing, Advances in Mechanical Engineering and Mechanical Sciences. He also sits on the editorial board for Micromachines, Nanomanufacturing and Metrology. He obtained his PhD in ultra precision manufacturing at Harbin Institute of Technology (China) and a second PhD in Precision Engineering at Leeds Metropolitan University (UK). From 2004 to 2007, he worked at Cranfield University as a research officer to develop freeform diamond turning/ grinding process and machines. From 2007 to 2012 he was a lecturer at Heriot-Watt University and established their Nanomanufacturing Laboratory. From 2012 to 2013 he was a Reader in ultra precision manufacturing at the University of Huddersfield where he led an Advanced Machining Research Group. His research has been funded by the EPSRC, EC, Royal Society and industry. His research interests include ultra precision machining brittle materials, freeform machining, precision motion control, hybrid micromachining and FIB nanomanufacturing, as evidenced by two books and more than 100 papers in peer-reviewed highly ranked journals. He chaired two IEEE International Conferences in Automation and Computing in 2014 and 2015. He won the UK Institution of Mechanical Engineers (IMechE) 2015 Ludwig Mond Prize for his work on the application of digital technology in micro- and nano-manufacturing.



INVITED SPEAKERS

Dr Conor O'Mahony, Micro & Nano Systems Centre, Tyndall National Institute, University College Cork, Ireland

“Development and industrialisation of polymeric microneedle technologies for transdermal sensing and diagnostics”

Biography:

Dr. Conor O'Mahony is a Senior Research Scientist with the Tyndall National Institute, Cork, Ireland, and an Adjunct Professor at Chongqing Technology and Business University, China. His team is focussed on the development of Micro Transdermal Interface Platforms (MicroTIPs) - high-value, wearable systems that combine

transdermal delivery, diagnostics, self-awareness and communications capabilities. These 'smart patches' interact with the outermost skin layers in a minimally invasive manner, and will blur the lines between implantable medical devices and the current generation of wearable electronics. Major projects currently underway by the team include the development of intelligent wound monitoring hardware, smart drug delivery systems, and wearable diagnostic technologies. These projects form part of Tyndall's ICT for Health strategy, following a technology roadmap towards the development of multifunctional 'smart patches' for theranostic applications.

He is a member of the Editorial Board of Journal of Micromechanics and Microengineering, has published over fifty peer-reviewed journal articles, and has filed eleven patent applications in the field of MEMS and micromachining. Dr O'Mahony has chaired two international conferences in Cork, and was a member of the team which received the inaugural University College Cork Research Team of the Year Award 2012.

