# NNT2023

Nanoimprint and Nanoprint Technologies

October 9-11, 2023

BOSTON SEAPORT

*updated October 5, 2023*

## Monday, October 9

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| 10:30 | Registration |
| 11:00 | Lunch |
| 12:00 – 2:20 | **Session 1 - Optics 1**<br>12:00 Welcome and Introduction<br>12:10 Recent Advances in Flat Optics of Metasurfaces<br>**Federico Capasso** (Plenary Speaker)<br>1:00 XR waveguides – Complete loop from the simulations to optically verified performance of diffractive waveguides<br>**Ismo Vartiainen** (invited)<br>1:20 Direct Full Wafer Nanoimprinting for High Efficency All-Inorganic Metalenses and Waveguides<br>**Vince Einck** (invited)<br>1:40 Wafer level nano-optics solution for AR glasses<br>**Kevin Lou** (invited)<br>2:00 Fabrication and practical applications of optical metasurfaces<br>**Amir Arbabi** (invited) |
| 2:20 | Break |

3:10 – 6:05

## Session 2 - Optics 2

3:10 Direct NIL patterning of sol-gel based metal oxides, with controlled refractive index from 1.2 to 2.7, on 8 inches wafers; applications in optics, photonic, and gas sensing.
**Marco. Abbarchi, Mehrnaz Modaresialam, Martin. O'Byrne, Badre Kerzabi, Zeinab. Chehadi, Ye. Zhou, and David Grosso** (invited)

3:30 Diffraction-based optical diffuser inspired by Morpho butterfly's nanostructure
**Akira Saito, Kazuma Yamashita, Takuma Hattori, and Yuji Kuwahara** (invited)

3:50 Optimizing the Residual Layer Uniformity Using Inkjet Printing Technology for AR Applications
**Fabian Kloiber, Simon Drieschner, Bas Le Grand, Joost Hermans, Vijay R. Kolli, Marc Hennemeyer**

4:10 Tailored polymers for wafer-level optics manufacturing
**Stephan Prinz** (invited)

4:25 Nanoimprint Lithography Using Novel Optical Materials For AR|MR Devices
**Shree Deshpande** (invited)

4:45 Matching material and process - The route to success for high-volume manufacturing of high-quality imprinted lenses
**Markus Brehm, Paige Deshler, Mikhail Begel, Andrea Kneidinger and Stephan Prinz**

5:05 Adaptable large area metasurfaces for customised applications
**N. Dimogerontaki, N. Matthaiakakis, N. Papanikolaou, N. Kehagias** (invited)

5:25 Visible Metalens Volume Production Line
**Bradley R Williams, Daniel Bacon-Brown, Matthew C. George, Rumyana V Petrova, Adam W. Korb, Jamie C. Stocks** (invited)

5:45 30 Years Path to Subwavelength Optical Elements Development, Application, and Fabrication
**Stephen Y. Chou** (invited)

6:15 Posters and Networking Reception in the Exhibit Hall

# Tuesday, October 10

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| | Continental Breakfast |
| 9:00 – 10:00 | **Session 3 - Optics 3**<br>9:00 Filler-Free NIL Compatible Ultra-High Refractive Index Resins for Photonic Applications<br>**Carlos Pina-Hernandez, Kaito Yamada, Keiko Munechika**<br>9:15 Fabrication of moth-eye-structured roll mold and application of moth-eye-structure<br>**Jun Taniguchi**<br>9:30 Study on induced strain during releasing process for slanted grating structure in nanoimprint process<br>**Yuusei Kunitou, Masaaki Yasuda, Yoshihiko Hirai**<br>9:45 Development of sub-wavelength structure optics by injection molding process<br>**Kazuma Kurihara, Genki Kuwano and Hokari Ryohei** (invited) |
| 10:05 | Morning Break in Exhibit Hall |

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| 10:30 – 12:40 | **NIL Ecosystem Session 1**<br>10:30 Unlocking the Invisible: The Revolutionary Potential of Metamaterials<br>**George Palikaras** (Keynote Speaker)<br>11:00 Unlocking High Performance Waveguides at Scale with Jet and Flash Imprint Lithography<br>**Scott Carden** (invited)<br>11:20 Advanced Displays: The Material Difference<br>**Peter C Guschl, Serpil G Williams, Grace E McClintock** (invited)<br>11:40 Update on fast prototyping and manufacturing of metalenses<br>**Theodor Nielsen** (invited)<br>12:00 NIL Mastering using advanced manufacturing imaging technology<br>**Brid Connolly, Dr. Martin Sczyrba** (invited)<br>12:20 NIL processing in a 300mm CMOS Fab line<br>**Eleonora Storace, Mohamed Asbahi, Pau Guell I Grau, Steve Smout, Myriam Willegems, Bogumila Kutrzeba Kotowska, Silvia Lenci, Matt Traub** (invited) |
| 12:40 | Lunch |

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| 1:30 – 3:30 | **NIL Ecosystem Session 2**<br>1:30 Advantages of Inkjet Coating Combined with Nanoimprint Lithography in Nanostructured AR Waveguide Fabrication<br>**Johanna Rimbock, Patrick Schuster, Christine Thanner, Lisa Vsetecka, Enrique Lopez, Andrea Kneidinger** (invited)<br>1:50 Large-area Nanoimprint Lithography as a solution for mass manufacturing of AR optics<br>**Nico Jansen** (invited)<br>2:10 300mm soft-NIL of functional materials for photonic- and bio- applications<br>**Marc A. Verschuuren**<br>2:30 All the Places Nanoimprinting Can Go: Patterning Carbons, Ceramics and Metals for Advanced Devices<br>**Jim Watkins** (invited)<br>2:50 The Microlens Revolution in Automotive Lighting and the Requirements for Future Imprint Production Tools<br>**Reinhard Voelkel** (invited)<br>3:10 Establishing a Nanoimprint Lithography Ecosystem<br>**Jin Choi** (invited)<br>3:30 Process solutions that enabled the industrialization of NIL technology<br>**Patrik Lundström** |
| 3:50 | Afternoon Break in Exhibit Hall |
| 4:20 | **Roundtable:**<br>**Push/Pull for Broadly Commercializing NIL** |
| 6:00 | **Dinner Cruise on Boston Harbor**<br>Sponsored by:<br>pixelligent<br>NIL TECHNOLOGY |

# Wednesday, October 11

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| | Continental Breakfast |
| 9:00 – 10:30 | **Session 4 - Process 1**<br>9:00 Bio-Based Photo-Initiators for UV-Nano-Imprint Resins<br>**Dieter Nees** (invited)<br>9:20 Study of the transfer of a biosourced resin by thermal nanoimprinting<br>**Paule Durin, Celine Chevalier, Aziz Benamrouche, Radoslaw Mazurczyk, Yann Chevolot, Didier Leonard, Jean-Louis Leclercq** (invited)<br>9:35 Next generation NIL materials - an evolution from lab to fab<br>**M. Lohse, M. Messerschmidt, N. Heidensohn, S. Gruetzner, A. Schleunitz, and G. Gruetzner** (invited)<br>10:05 Low-cost and scalable manufacturing of optical metasurfaces in the visible using engineered optical materials (PER, low-loss a-Si:H, and hybrid ALD structural resin)<br>**Junsuk Rho** (invited) |
| 10:30 | Morning Break in the Exhibit Hall |
| 11:00 – 12:20 | **Session 5 - Process 2**<br>11:00 Room temperature imprint and extrusion based printing of water-based microparticle inks towards glass microfluidic devices<br>**Helmut Schift**<br>11:15 Digital patterning of slippery surfaces for liquid manipulation<br>**Sang Hoon Lee, Woo Young Kim, Seok Kim and Young Tae Cho** (invited)<br>11:35 Continuous nanopatterning of very large areas using nanocoining and roll-to-roll nanoforming<br>**Lauren Micklow, B Diane Martin, Nichole Cates, Dennis Slafer, Stephen Furst**<br>11:50 Scalable High Throughput Additive Manufacturing of Nano and Microelectronics<br>**Ahmed Busnaina**<br>12:05 Conformal Electrochemical Nanoimprinting of Silicon: Towards Bio-Inspired Infrared Meta-Optics<br>**Bruno Azeredo** |

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| 12:20 | Lunch |
| 1:00 | Posters and Networking Reception in the Exhibit Hall |
| 2:00 – 3:50 | **Session 6 - Bio**<br>2:00 Nanoimprint Technology for Biosensing and Metadevices<br>**Stella W. Pang** (Keynote Speaker)<br>2:30 Nanoimprinting of Micro- and Nanostructures for Life Science Applications<br>**Michael J. Haslinger, Sonja Kopp, Michael M. Muehlberger** (invited)<br>2:50 Porous Nanosheet Wrapping Fabricated by Nanoimprinting Technique for High Quality Bioimaging<br>**Yosuke Okamura** (invited)<br>3:10 Printing Nanoporous Metallic Membranes For Improved Stem Cell Delivery<br>**Thomas J. Webster** |
| 3:40 | Afternoon Break in the Exhibit Hall |
| 4:35 | Farewell |
| 6:00 | Committee Dinner |

# Thursday, October 12

7:45 - 3:30

## Optional Tour of Advanced Print and Roll-to-Roll Manufacturing Demonstration Facility at UMass Amherst

Transportation and Lunch Provided (space is limited to first 50 participants)

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| 7:45 | Bus Departs for UMass Amherst |
| 10:00 | Bus Arrives UMass Amherst |
| 10:30 | Convene Life Science Laboratories Conference Center S330<br>*Coffee Break* |
| 10:45 | Facilities and Capabilities Overview and Discussion |
| 11:45 | Catered Lunch - Networking<br>Sponsored by:<br>UMassAmherst \| Institute for Applied Life Sciences |
| 12:30 | Facility Tours |
| 1:15 | Wrap-up |
| 2:00 | Bus Departs for Boston Seaport |
| 4:00 | Bus Arrives at Seaport Hotel |

## EXHIBIT HALL

NIL TECHNOLOGY

JEOL

OpTool

SCIL
Nanoimprint solutions

AUTEX

HighRI Optics, Inc

NTT AT

MYRIAS
OPTICS

UMassAmherst | Core Facilities
Roll-to-Roll Fabrication
Institute for Applied Life Sciences
University of Massachusetts Amherst

obducat

micro resist technology

# Poster Session

- UV-Nanoimprinting to Modify 3D-Printed Ceramic Surfaces
  **Sonja Kopp, Abhijeet Lale, Viktorija Jonaityte, Michael J. Haslinger, Martin Schwentenwein, Francesco Moscato, Michael M. Muehlberger**
- Fabrication of Surface Microstructures and Investigation of their Influence on the Interaction with Blood for Use in a Left Ventricular Assist Device
  **Marta Bonora, Stjepan Perak, Sonja Kopp, Sarah Linnemeier, Richard Benauer, Markus Lunzer, Francesco Moscato, Marcus Granegger, Michael M. Muehlberger**
- Large-area fabrication of a Morpho butterfly-inspired optical diffuser using nanoimprint lithography
  **Kazuma Yamashita, Takuma Hattori, Yuji Kuwahara, and Akira Saito**
- Approach for process design solving invers problem by deep learning for nanoimprint process
  **Yuusei Kunitou, Masaaki Yasuda, Yoshihiko Hirai**
- Local Modification of Polymer Properties in Nanoimprint
  **Roberto R. Panepucci**
- Fabrication of high formable shape memory alloy nano/micro size cilium using thermal nanoimprint
  **Junpei Sakurai, Kanta Sato, Chiemi Oka, and Seiichi Hata**
- Fabrication of diffraction textured substrate for DSSCs
  **Ryutaro Kimura, Chiemi Oka, Seiichi Hata, Junpei Sakurai**
- Towards Nanoimprinted Waveguides made of Inkjet-able High Refractive Index Materials
  **Michael J. Haslinger, Gerald Stubauer, Peter Bauer, Sebastian Kauscheder, Viktorija Jonaityte, Katerina Masopustova, Sonja Kopp, Michael Muehlberger**
- Functional vertical sidewalls and draft angles for easy demolding in the same mold in thick epoxy resist
  **Helmut Schift**
- Direct Imprinting of Aqueous TiO2 Nanocrystal Dispersions for Sustainable Metasurface Fabrication
  **Chavez Lawrence**
- How far does a droplet of UV-curable liquid spread between the mold and silicon surfaces in nanoimprinting?
  **Masaru Nakagawa, Akiko Onuma, Hiromasa Niinomi, Shintaro Itoh, Kenji Fukuzawa, and Toshiya Asano**
- Imprinting of residual-layer-thickness optimized large micro-structures enabled by the new organic UV-patternable resist «mr-NIL210SF»
  **Martin Messerschmidt**
- Non-destructive in-line nano-metrology techniques for roll to roll nanoimprint lithography manufacturing processes

**I. Raptis, V. Constantoudis, K. Tourlouki, T. Tachtsidis, C. Katsogridakis, E. Almpanis, N. Papanikolaou, A. Stellas, D. Goustouridis, P. Argitis, N. Kehagias**

- High-Throughput Fabrication of TiO2-based Metalenses with Absolute Efficiencies Over 80% and Relative Efficiencies Over 90%
  **Dae Eon Jung, Alex Dawicki, Vincent J. Einck, Lucas D. Verrastro, Amir Arbabi, and James J. Watkins**

- Nanoporous Carbon Pillars Fabricated via Nanoimprint Lithography as Structural Metamaterials for Energy Storage Devices
  **Ayush Bharadwaj, Zhongyuan Li, Varun Pande, Seok-Woo Lee, James J. Watkins**

- Mechanically Tunable Plasmonic Device Fabricated with Dielectric Slide Ring Elastomer Bragg Mirror and Integrated Gold Metasurface
  **Sravya M. Nuguri, Lucas D. Verrastro, Daniel Shreiber, Ben Cerjan, Vincent Einck, Naomi J. Halas, Mark H. Griep, and James J. Watkins***