

EPIC Technology Meeting on Photonics for Miniaturized Optics: From Components to Use-cases at Sony DADC

Synchronization of Process and Material to Achieve Best Results for Micro Optics

Thomas Achleitner | Business Development Manager



18-19 September 2024. Salzburg, Austria

EPIC Technology Meeting on
Photonics for Miniaturized Optics:
From Components to Use-cases at Sony DADC



Leading supplier of wafer processing equipment for the nanotechnology, MEMS and semiconductor markets

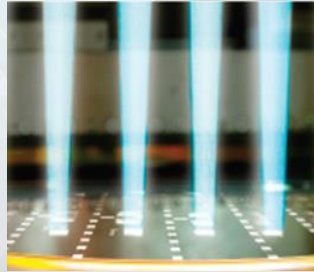
Founded in 1980 by DI Erich and Aya Maria Thallner. More than 1400 employees worldwide

Headquarters in Austria, with fully owned subsidiaries in the USA, Japan, South Korea, China and Taiwan

Recent Developments



GEMINI® FB
Hybrid Bonding



EVG® MLE™
Maskless Exposure
Technology



EVG® HERCULES® NIL
SmartNIL® HVM
Up to 300 mm



EVG® 770 NT
S&R NIL System



EVG® 7300
SmartNIL® and WLO
Up to 300 mm

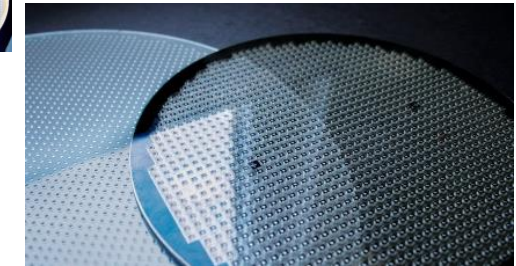
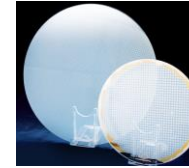
Nanoimprint Lithography (NIL) Developments

Nano Imprint Lithography (NIL) | Focus Topic



NIL is a cost-effective and flexible technology to enable nanostructured surfaces as well microstructures on wafer-level

- Volume-proven replication technology (= imprinting)
- Parallel processing of hundreds or thousands of micro- and nanostructures
- High degree of flexibility on replicable structures on substrates



NIL Infrastructure / Ecosystem



• **Design** → Close collaboration with master suppliers



• **Material** → Strong partnership with material vendors



• **Process**

- Step-and-Repeat Mastering
- SmartNIL®
- Lens Molding / Wafer Level Optics
- Lens Stacking



• **Equipment**

- Tools from R&D to fully automated HVM



NIL Photonics Competence Center → Innovation Incubator

- Helping to ramp up
- Access to available network and ecosystem

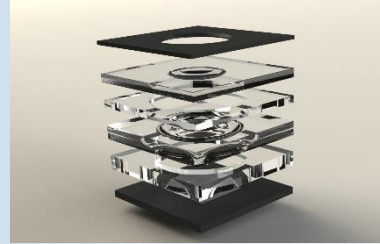
Meta Optical Applications

Displays & Augmented Reality

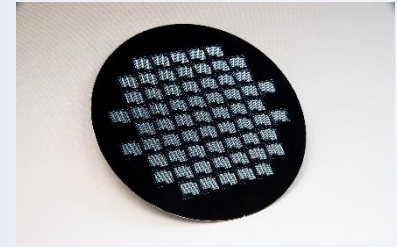
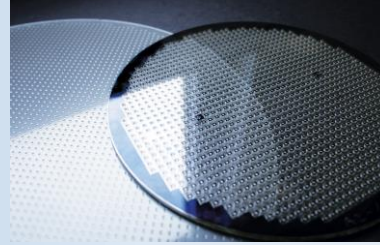
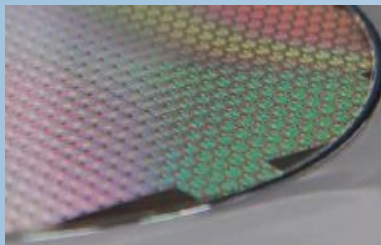
Sensors & Wafer Level Optics

Automotive

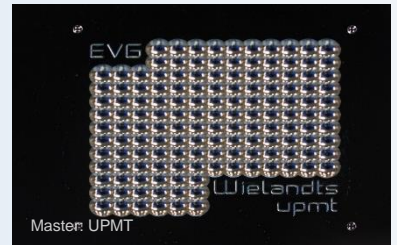
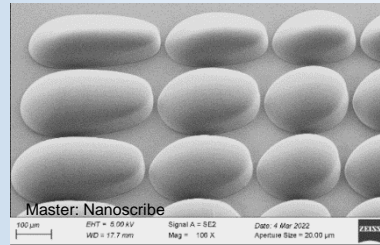
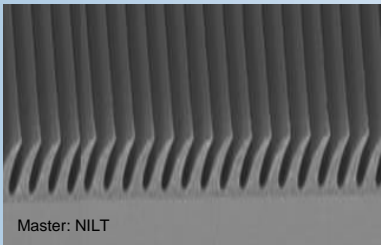
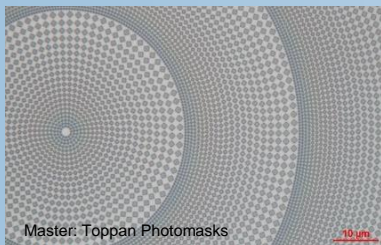
Application



Wafer



Structures





EVG[®]7300 combines

- ➔ SmartNIL[®]
- ➔ Lens Molding
- ➔ Stacking

SmartNIL[®]

Lens Molding

50 nm

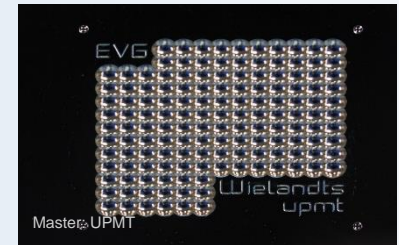
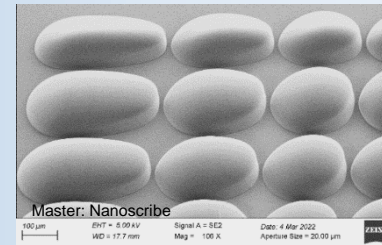
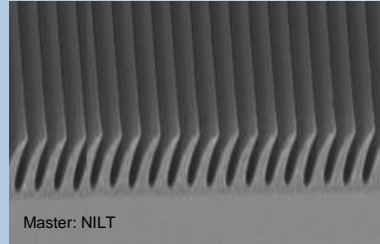
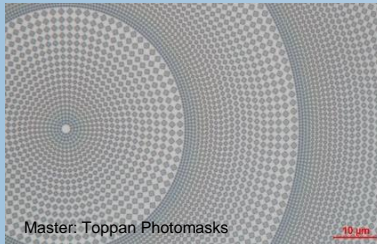
500 nm

5 μm

50 μm

500 μm

Structures

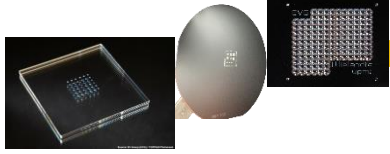


Freeform Microstructures | From Master Template to Multiple Imprints



S&R process

Single DIE Master



EVG[®]770 S&R System



Cure imprint polymer and de-emboss template



Move to next DIE and imprint again



S&R Master

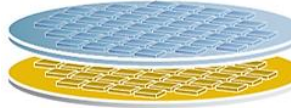


NIL imprint process

Working Stamp



Multiple Imprints



EVG[®]7300



HERCULES[®] NIL

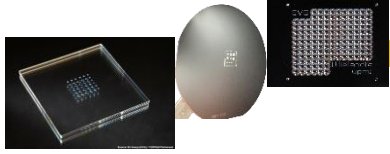


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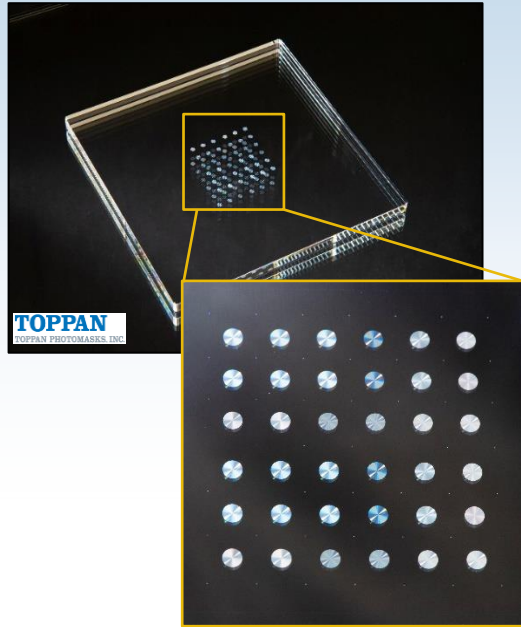


NIL imprint process



From a Single Lens to Waferlevel Optics | Process Flow

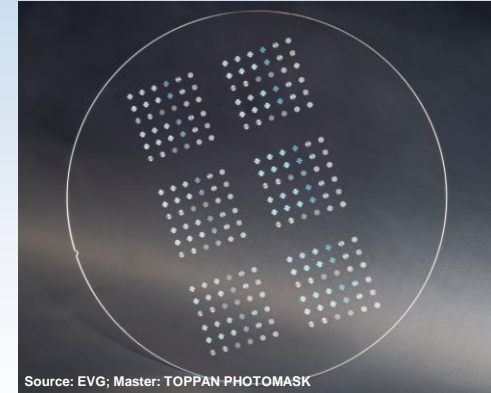
Single Die Master



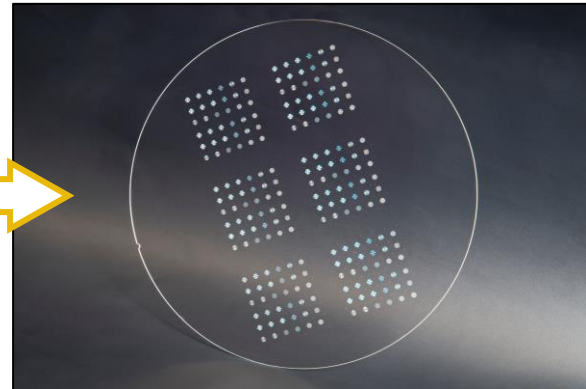
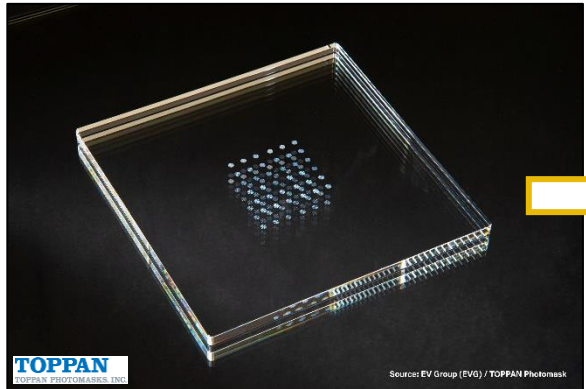
EVG®770 S&R System



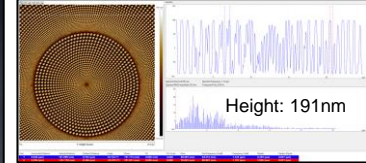
S&R Master



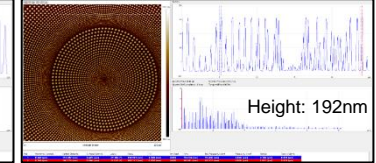
EVG[®]770 NT S&R | Metalenses - Process Results



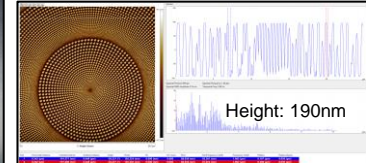
Die #1



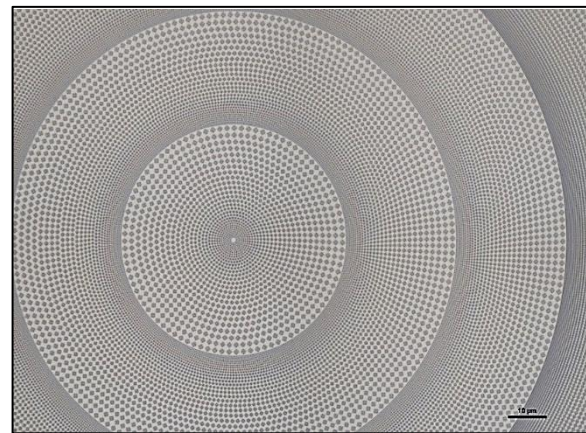
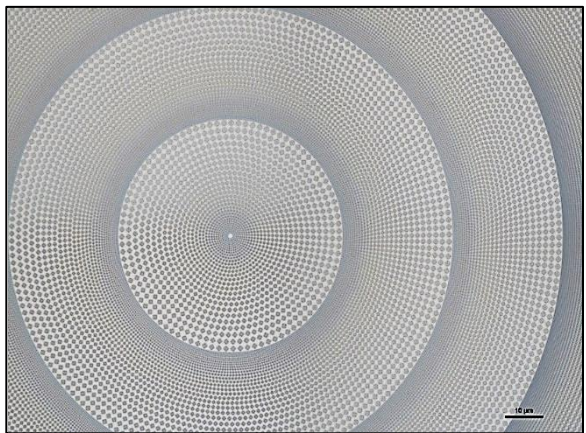
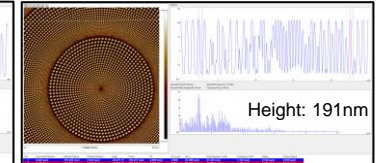
Die #3



Die #4



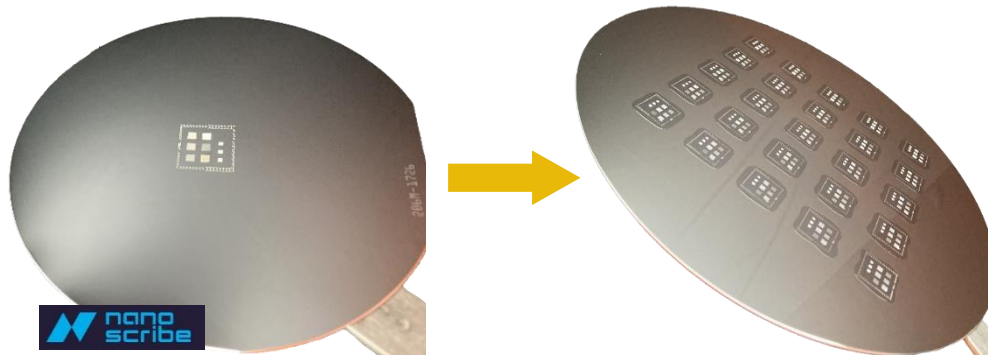
Die #6



Important: pattern fidelity and quality

- ➔ Stable pattern height of 190nm
- ➔ No missing pillars observable



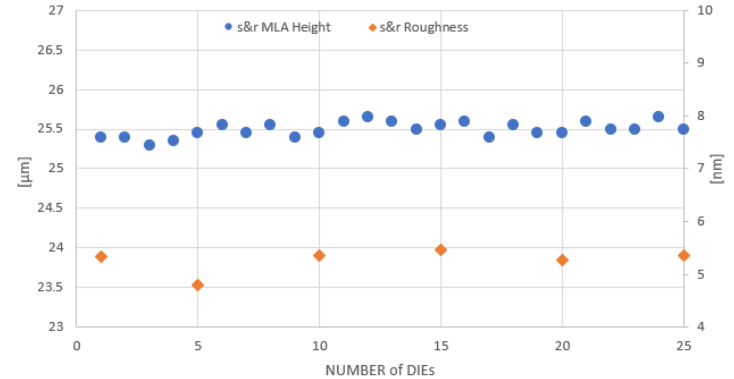
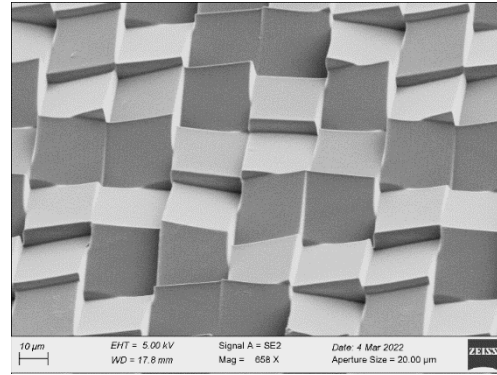
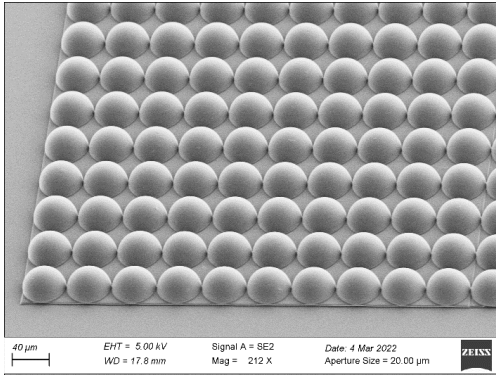


2PP Single Die Master

25 DIES by Step&Repeat

Important: pattern fidelity and surface roughness

- ➔ Stable pattern height of $25,5\mu\text{m} \pm 0,2\mu\text{m}$
- ➔ Low surface roughness $<6\text{nm}$

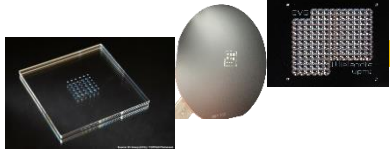


Freeform Microstructures | From Master Template to Multiple Imprints



S&R process

Single DIE Master



EVG[®]770 S&R System



Cure imprint polymer and de-emboss template



Move to next DIE and imprint again



S&R Master

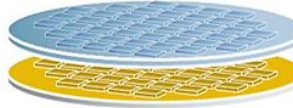


NIL imprint process

Working Stamp



Multiple Imprints



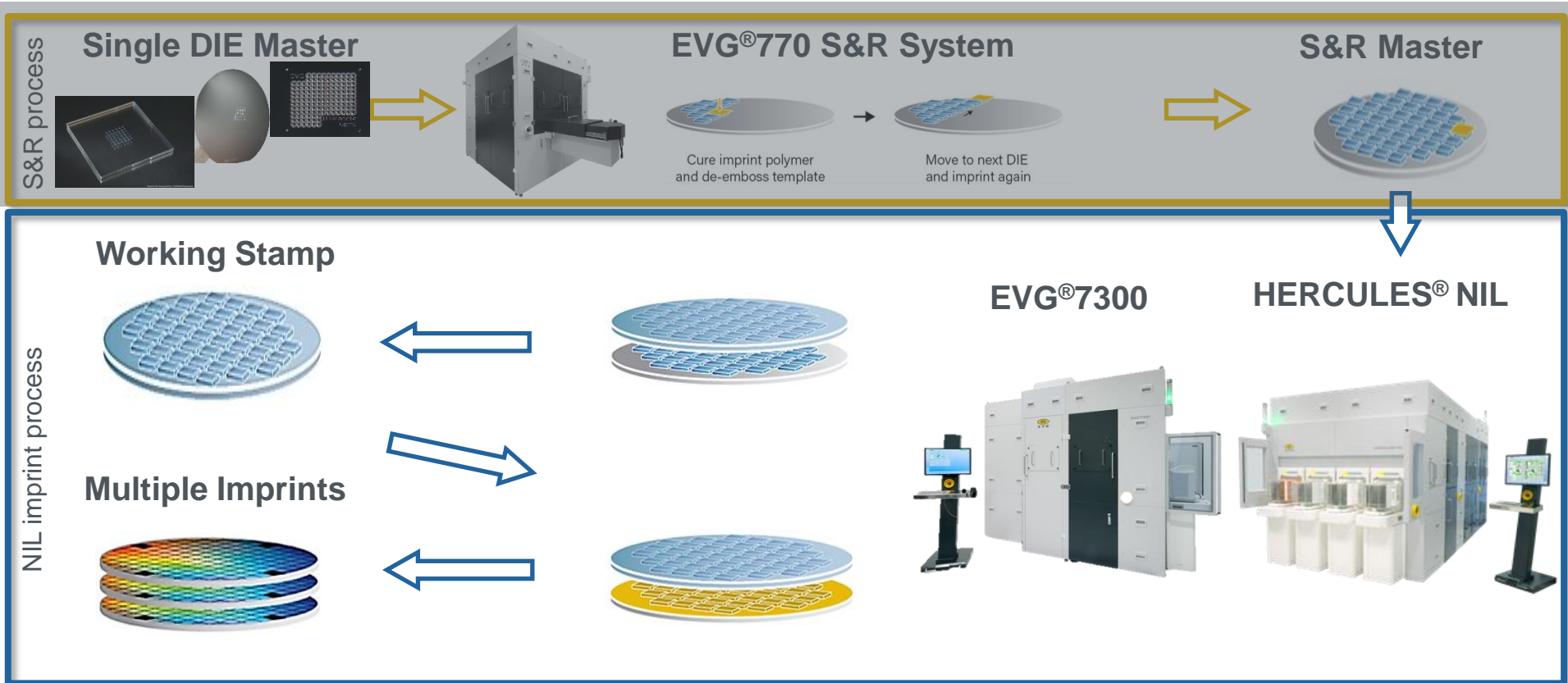
EVG[®]7300



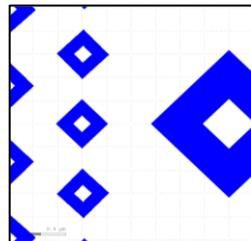
HERCULES[®] NIL



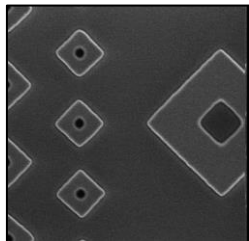
Freeform Microstructures | From Master Template to Multiple Imprints



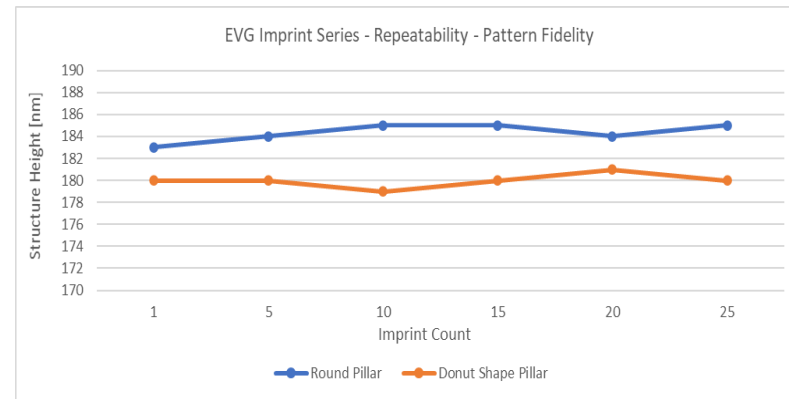
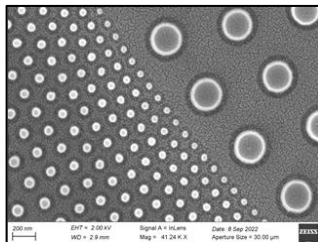
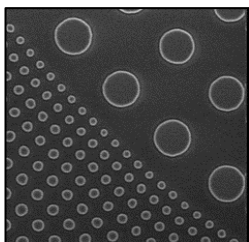
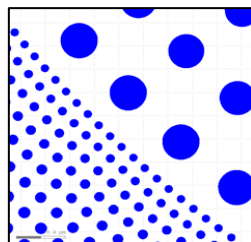
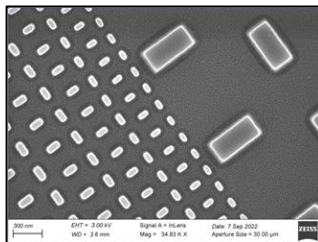
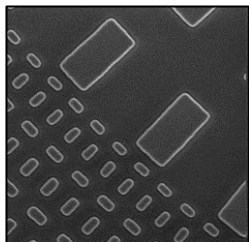
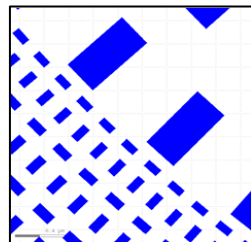
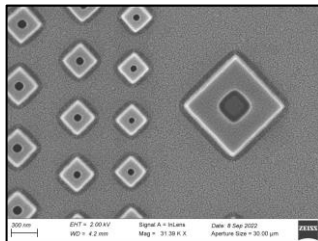
Design



TOPPAN
Quartz Master



EVG
SmartNIL® Imprint



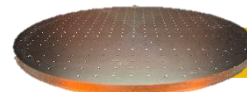
SmartNIL® enables replication of different geometries / orientation / dimensions in a single shot

- ➔ High Wafer-to-Wafer pattern fidelity
- ➔ Large area imprinting



→ Key aspects of the whitepaper

- **EVG & DELO** partner to show capabilities for an industrial solution for wafer-level lens molding
- **High volume production** by fully automated and parallel process
- **Highest flexibility** for alignment, curing and stacking
- Excellent and reproducible **pattern fidelity** along the entire process
- Outstanding **material compatibility**
- Superb **optical characteristics, reliability and processability**



Master

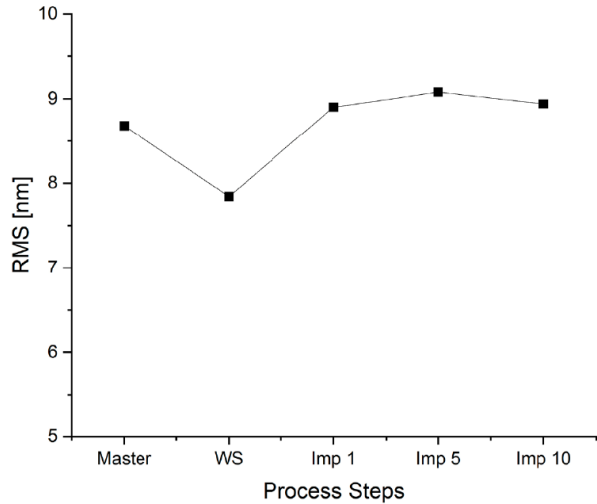


Working Stamp

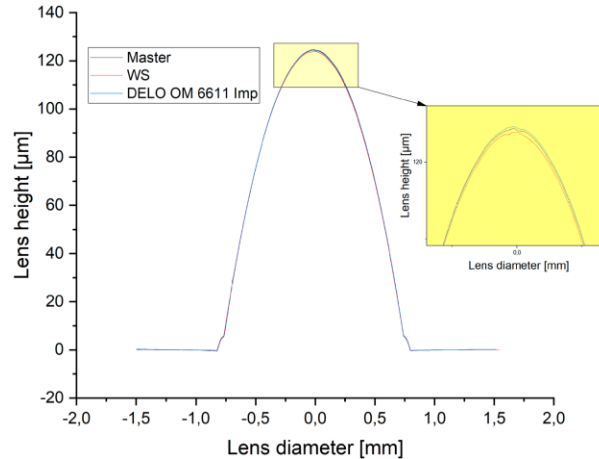


Multiple Imprints

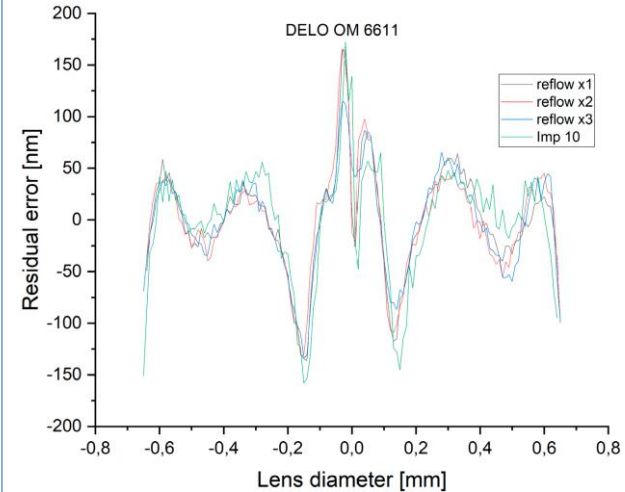
→ Lens Surface Roughness



→ Lens Shape



→ Reflow and Reliability



Constant lens surface roughness < 10nm RMS
Exact replication of the original lens shape over the entire process
Stable material to withstand reflow and reliability testing



EVG[®]7300 combines

- ➔ SmartNIL[®]
- ➔ UV Molding
- ➔ Stacking

SmartNIL[®]

Lens Molding

50 nm

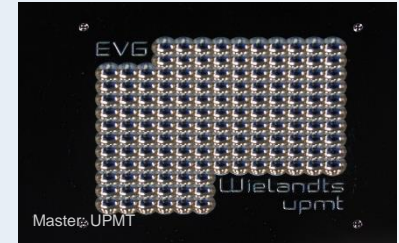
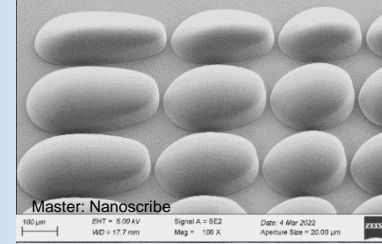
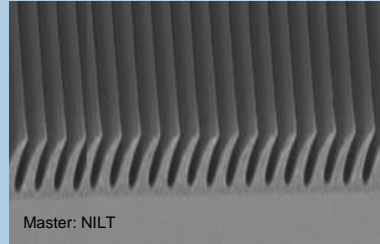
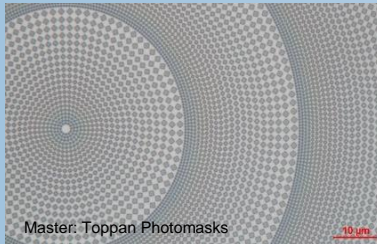
500 nm

5 μm

50 μm

500 μm

Structures



EV Group | NIL Key Markets & Application Areas



Structure

Master: Toppan Photomasks

Master: NILT

Master: Nanoscribe

5 μm

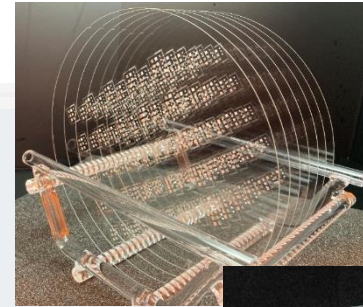
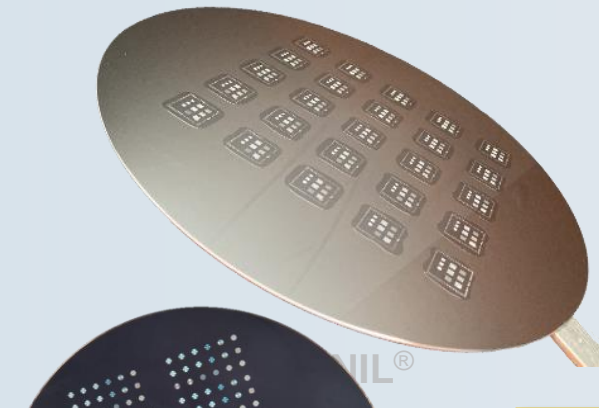
50 μm

Full Imprinting process in a single system

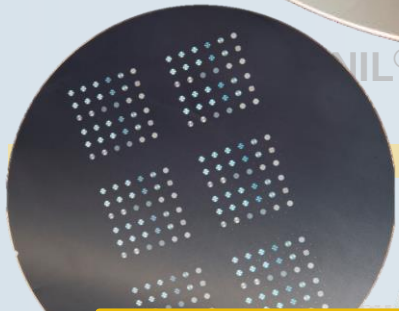
Lens



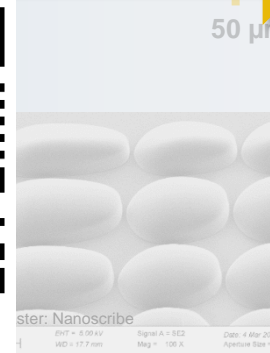
EV Group | NIL Key Markets & Application Areas



Full imprinting process in a single system



All Whitepapers →



Thank you!

Thomas Achleitner, Business Development Manager



May 2022

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