

Mirco-Optics Summit 2024

Advanced nanoimprint solutions for high precision consumer product features

Thomas Achleitner | Business Development

The banner features a background of glowing blue spheres with grid patterns, set against a dark blue field. Overlaid on this are large, overlapping orange and dark blue shapes. The text is arranged in a clean, modern layout with a mix of colors and fonts.

Micro-optics
SUMMIT & EXPO

Bringing together
the full value chain
for micro-optics

2-3 December 2024 in Amsterdam (NL)
Micro-Optics Summit & Expo

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

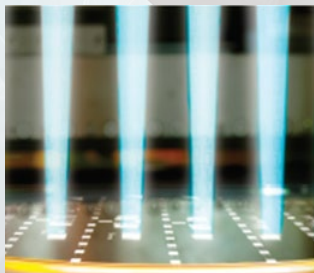
Founded in 1980 by DI Erich and Aya Maria Thalner. More than 1400 employees worldwide

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



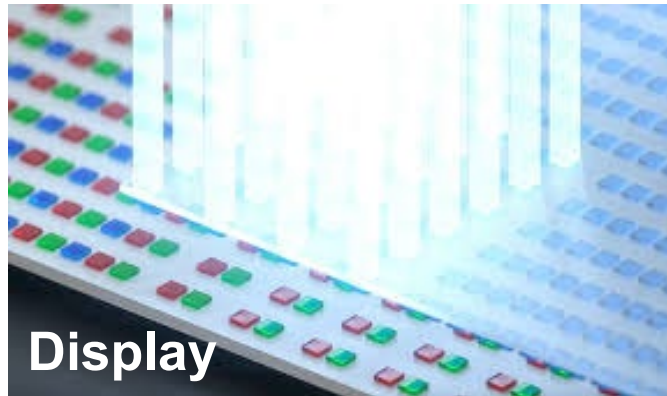
EVG® 770 NT
S&R NIL System



EVG® 7300
SmartNIL® and WLO
Up to 300 mm

Nanoimprint Lithography (NIL) Developments

Consumer Devices for EVG

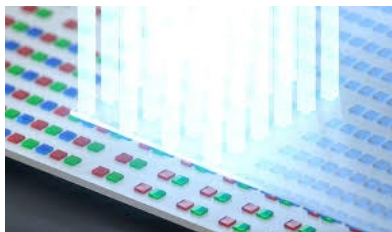


Market

AR VR



Display



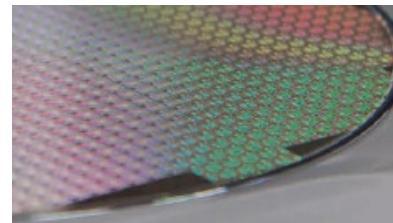
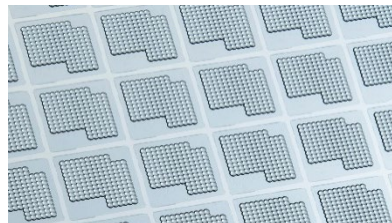
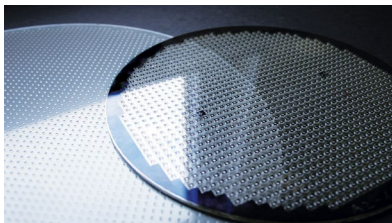
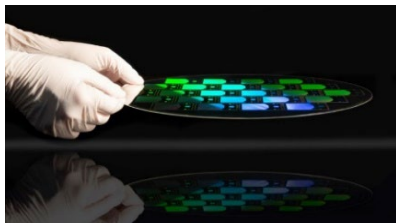
Automotive



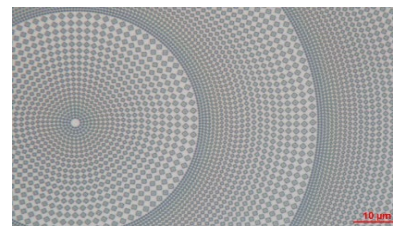
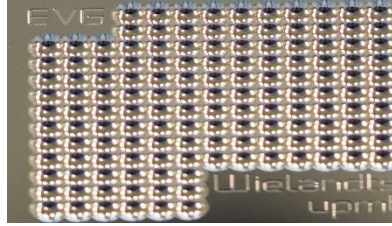
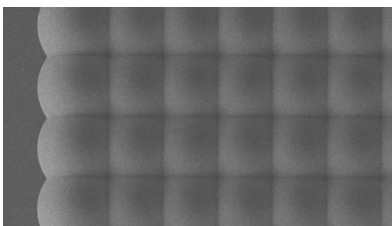
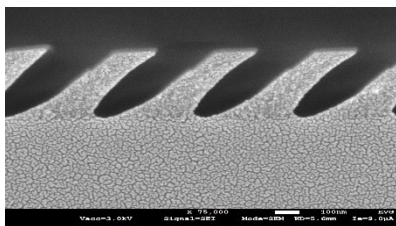
Sensing



Wafer



Structures



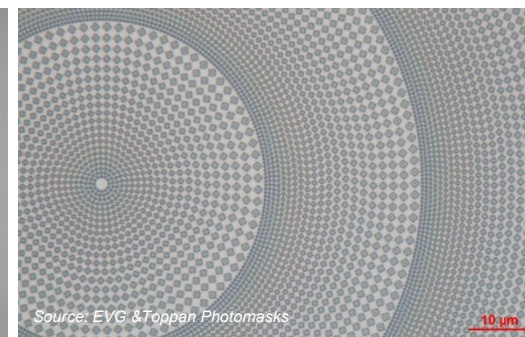
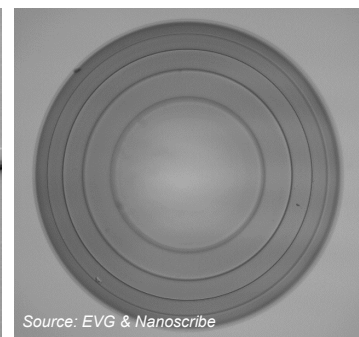
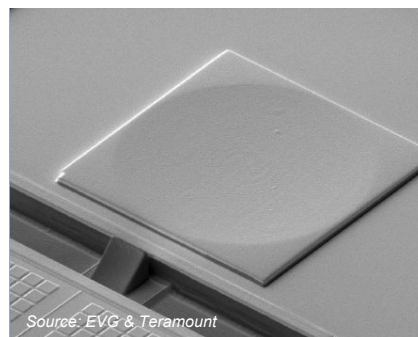
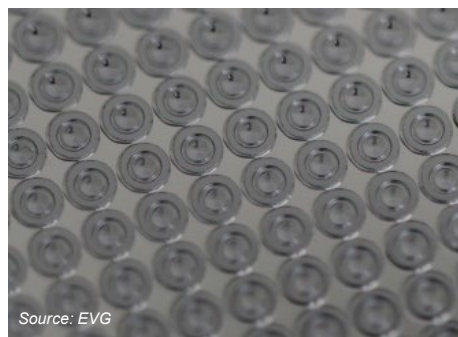
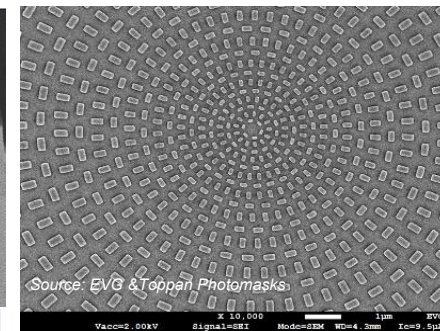
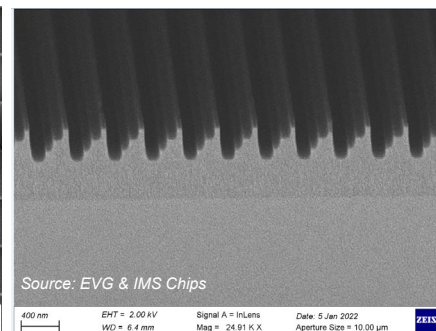
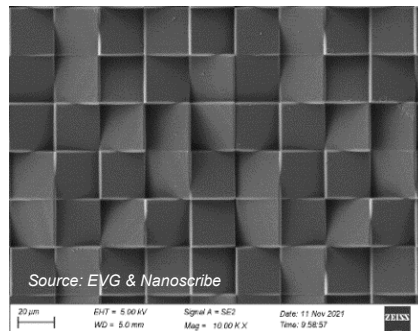
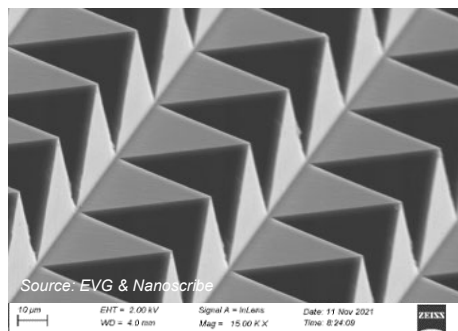
Surface Relief
Gratings

Mirco Lens Arrays

Wafer Level Optics

Meta Optical
Surface

NIL Structure Examples | Broad Range of Possibilities



Process capability for nano- and microstructures, also for complex shaped structures - in a single step!

Substrate sizes

- 2 inch to 12 inch
- mm range down to <250µm
- Panel level imprinting
- ...

Substrate types

- Silicon for electronics
- Glass wafers for optical applications
- SiC for high power applications
- Sapphire for LED production
- Germanium
- GaN optoelectronic applications
- Plastic substrates for lightweight waveguides
- ...



One technology serving different applications

Permanent Imprint Materials

- Optical grade materials for silicon photonics
- biologically functionalized materials
- High refractive index
- Low refractive index
- Low K materials for advanced packaging
- ...

Sacrificial Imprint Materials

- Etch transfer into different materials such as Si, SiO₂, TiO₂, AlO₃, GaN, InP, SiN

EVG[®]7300 UV Nanoimprint Lithography System

SmartNIL[®]

Lens Molding

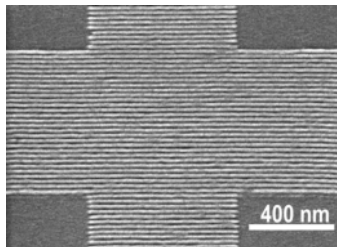
50 nm

500 nm

5 μ m

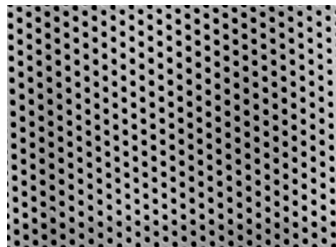
50 μ m

500 μ m



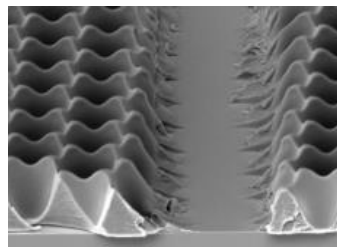
High Resolution Imprinting
[12.5 nm]

*(Source EVG; Master
fabricated by IMS)*



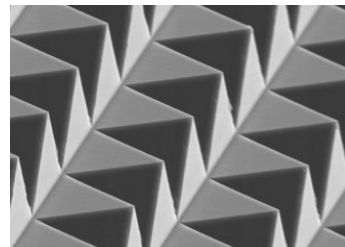
Photonic Crystal
[350 nm]

(Source EVG)



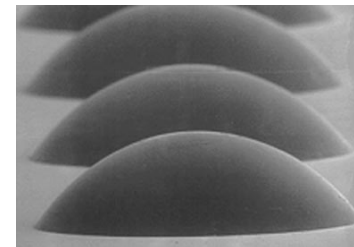
3D Anti reflective Structures
[7 μ m]

(Courtesy of Fraunhofer ISE)



Pyramidal Structures
[50 μ m]

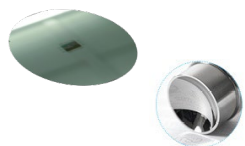
(Source EVG)



UV Lens Molding
[300 μ m]

(Source EVG)

Single DIE Master



EVG[®]770 S&R System



Cure imprint polymer
and de-emboss template



Move to next DIE
and imprint again



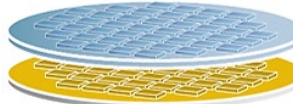
S&R Master



Working Stamp



Multiple Imprints



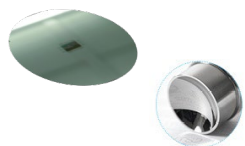
EVG[®]7300 SmartNIL[®] Module



HERCULES[®] NIL



Single DIE Master



EVG®770 S&R System



Cure imprint polymer
and de-emboss template



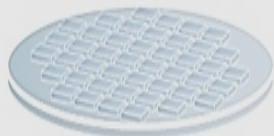
Move to next DIE
and imprint again



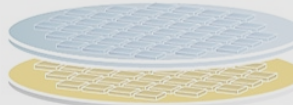
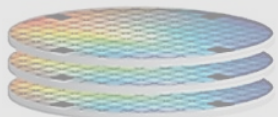
S&R Master



Working Stamp



Multiple Imprints



EVG®7300 SmartNIL® Module



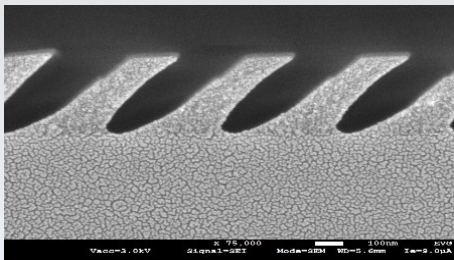
HERCULES® NIL



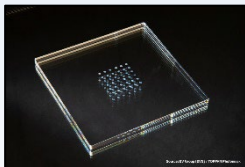
From a Single Lens to Waferlevel Optics | Why SmartNIL?

Surface Relief Gratings

Structures



Mastering



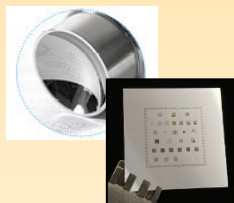
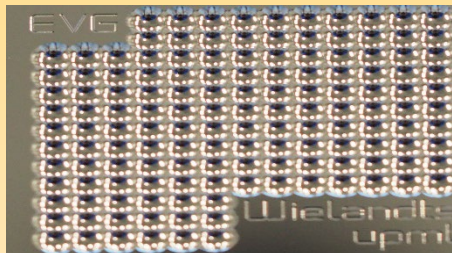
Single Die Master
E-beam + etch
By Tekscend

Limitation

Fully populated wafer:

➔ Long processing times
Expensive equipment

Wafer Level Optics

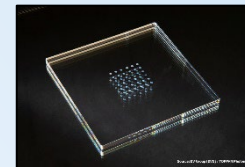
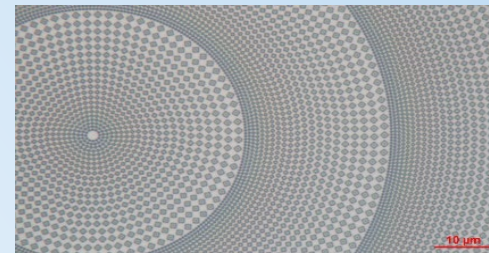


Single lens array:
Diamond turning
2PP Advanced 3D Print

Fully populated wafer:

➔ Long processing times
Expensive equipment

Meta Optical Surface



Single Die Master
E-beam + etch
By Tekscend

Fully populated wafer:

➔ Long processing times
Expensive equipment

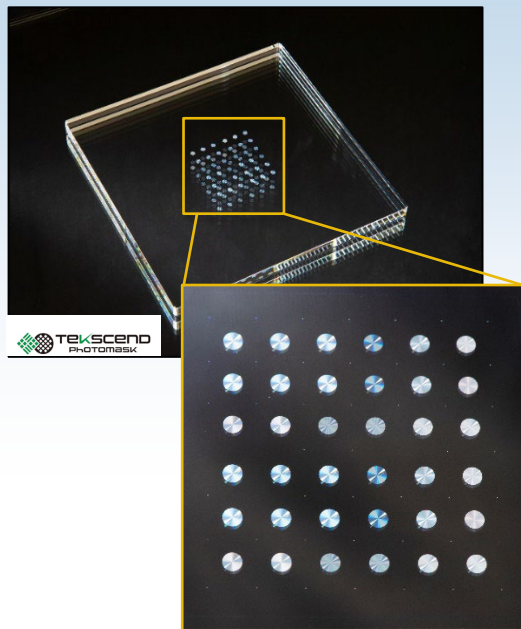
From a Single Lens to Waferlevel Optics | Process Flow

Template

200/300 mm Master

Multiple Imprints

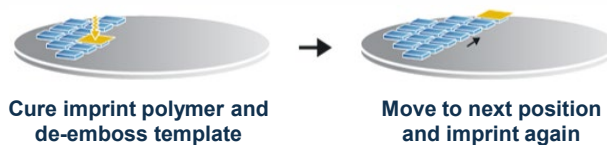
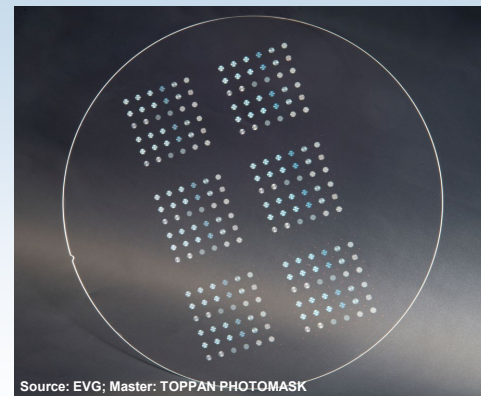
Single Die Master



EVG®770 S&R System

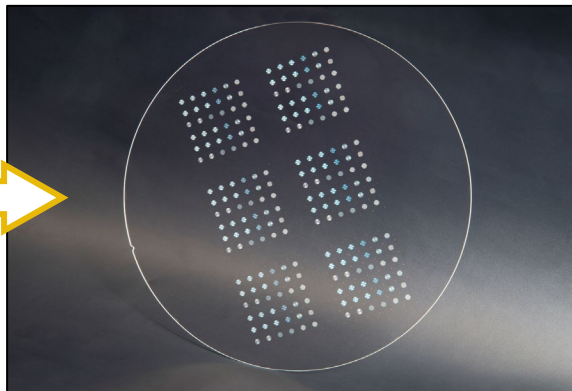
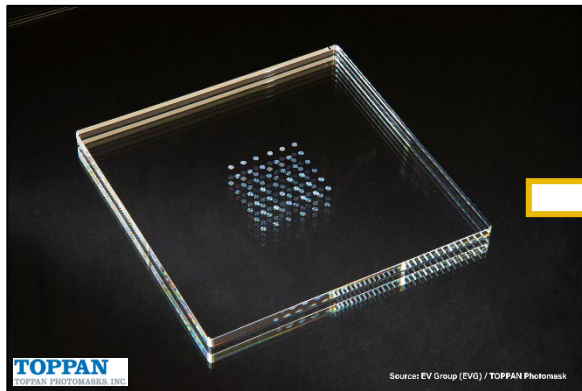


S&R Master

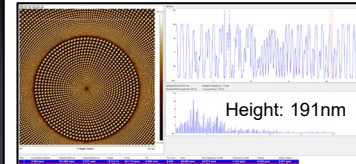


S&R Master

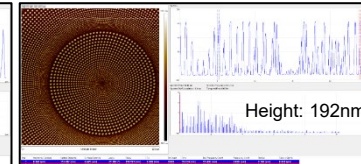
EVG®770 NT S&R | Metalenses - Process Results



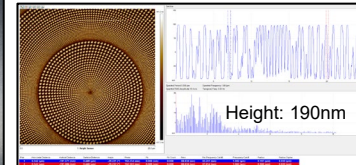
Die #1



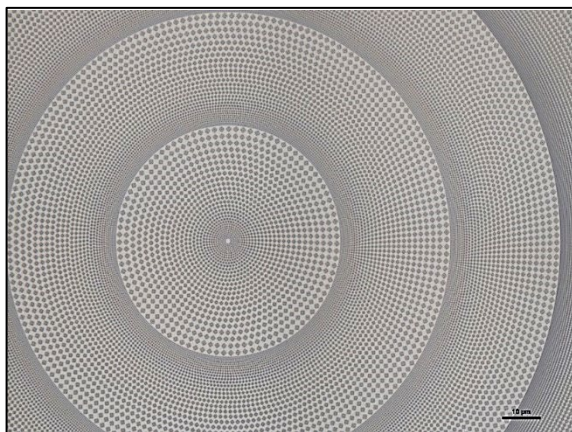
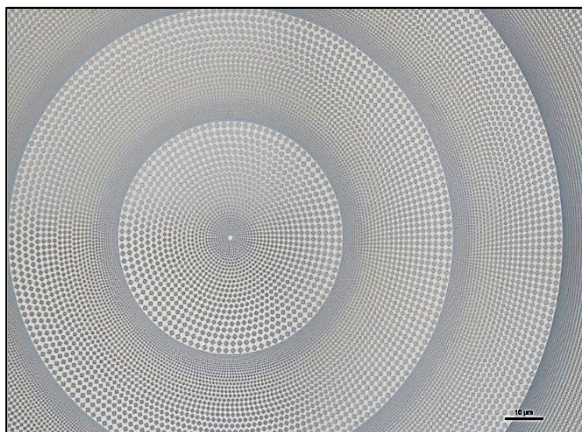
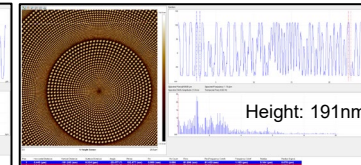
Die #3



Die #4

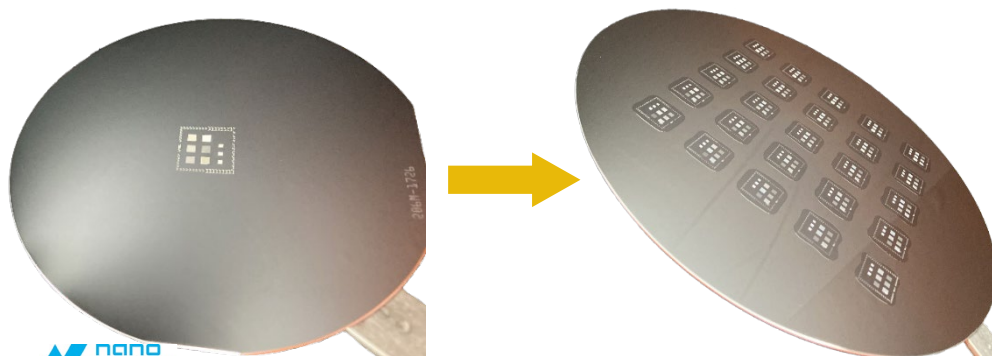


Die #6



Important: pattern fidelity and quality

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



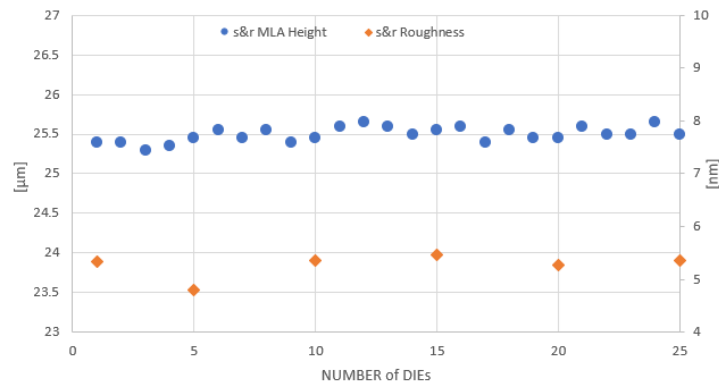
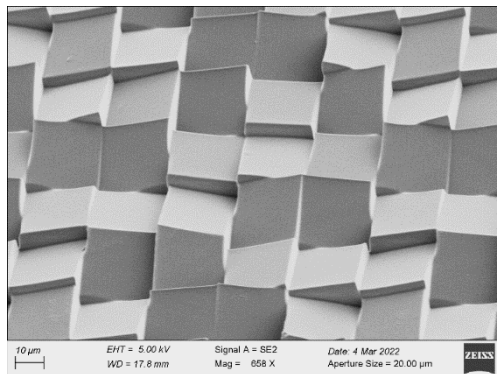
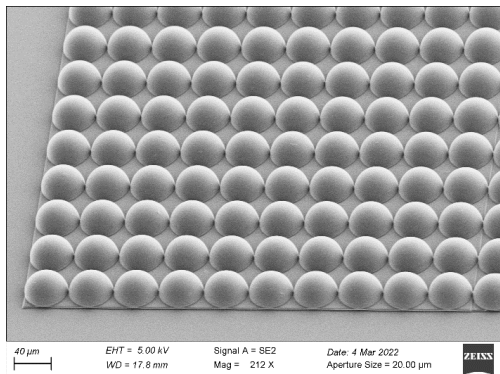
nano scribe

2PP Single Die Master

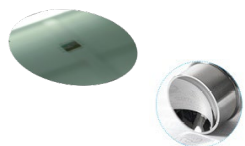
25 DIES by Step&Repeat

Important: pattern fidelity and surface roughness

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



Single DIE Master



EVG[®]770 S&R System



Cure imprint polymer
and de-emboss template



Move to next DIE
and imprint again



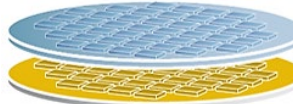
S&R Master



Working Stamp



Multiple Imprints



EVG[®]7300 SmartNIL[®] Module



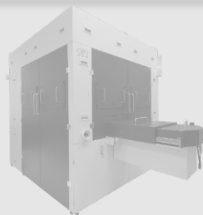
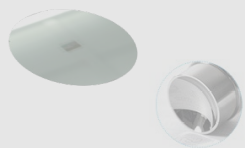
HERCULES[®] NIL



EVG NIL | S&R Mastering to Wafer Level Imprint



Single DIE Master



EVG[®]770 S&R System



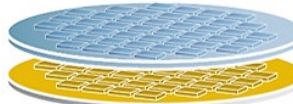
S&R Master



Working Stamp



Multiple Imprints

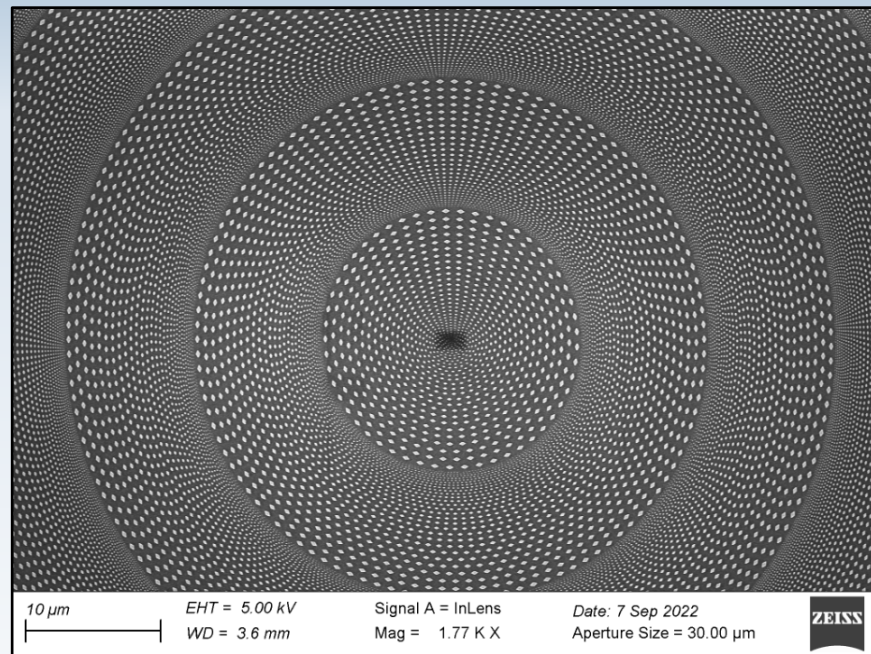
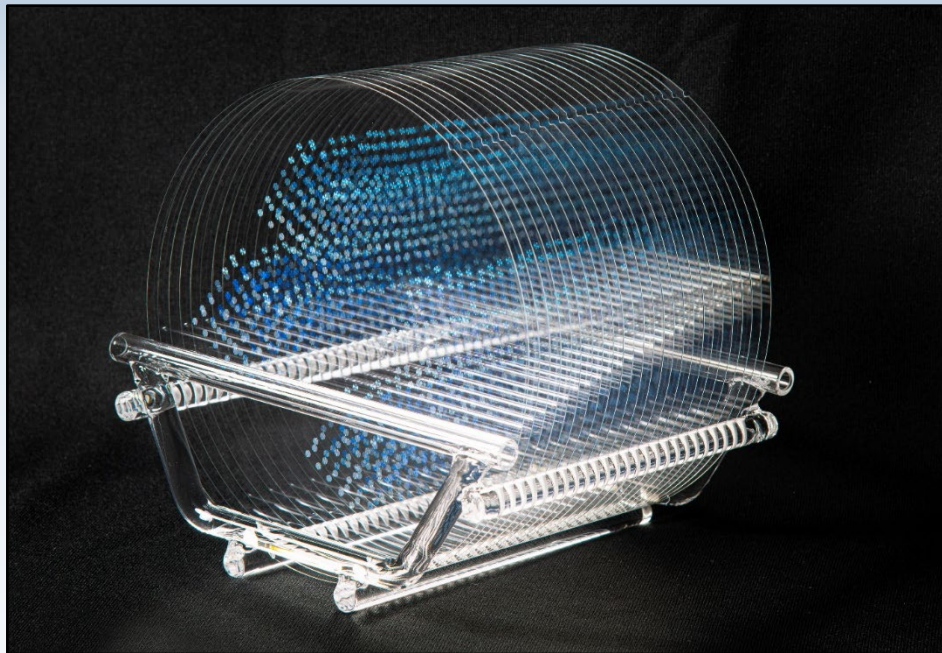


EVG[®]7300
SmartNIL[®] Module



HERCULES[®] NIL

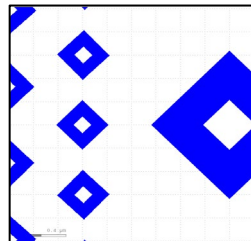




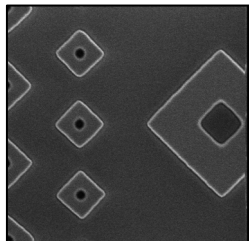
Fully automated EVG®7300 SmartNIL® replication of meta-type lenses using a S&R master template

EVG SmartNIL® | Design to Imprint – Pattern Fidelity

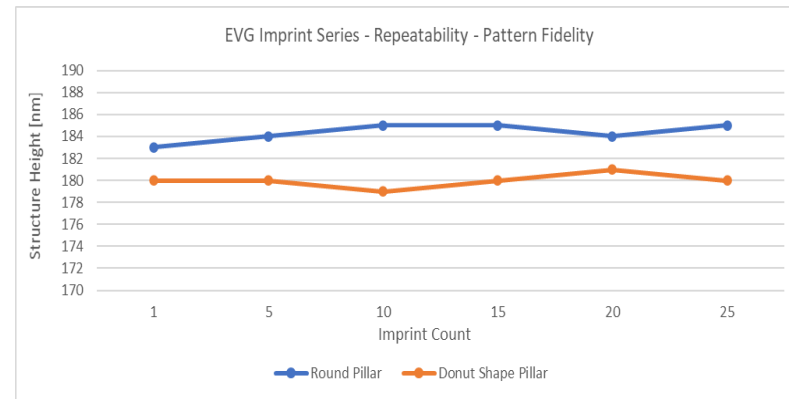
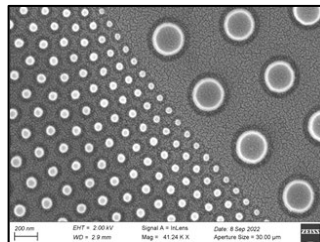
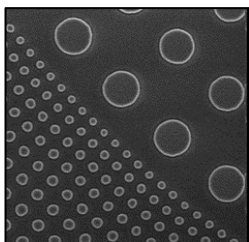
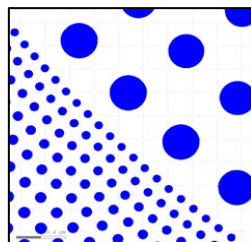
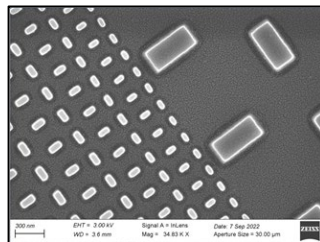
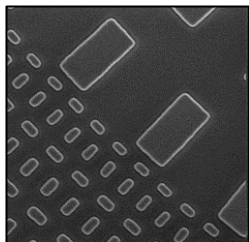
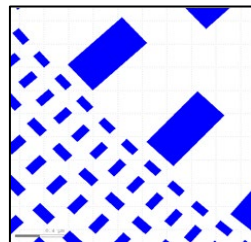
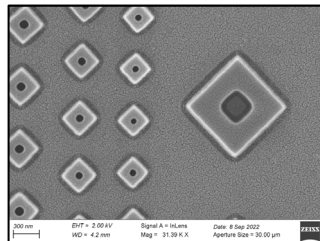
Design



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

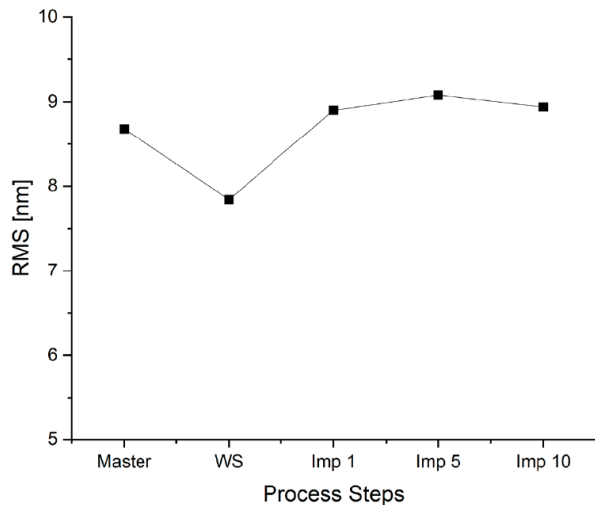
- **EVG & DELO** partner to show capabilities for an industrial solution for wafer-level lens molding
- **High volume production** by fully automated and parallel process
- **Highest flexibility** for alignment, curing and stacking
- Excellent and reproducible **pattern fidelity** along the entire process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



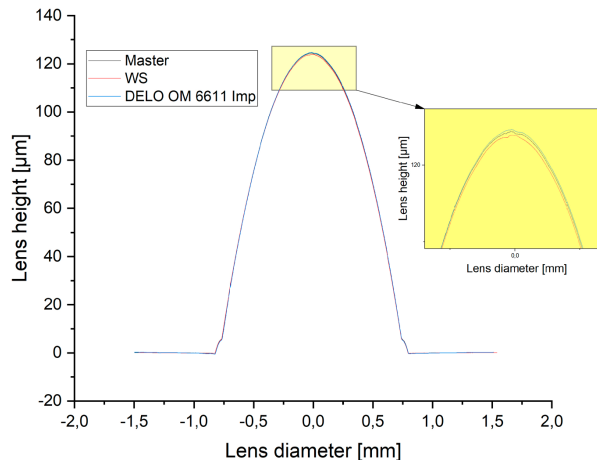
Wafer Level Optics | Results Summary



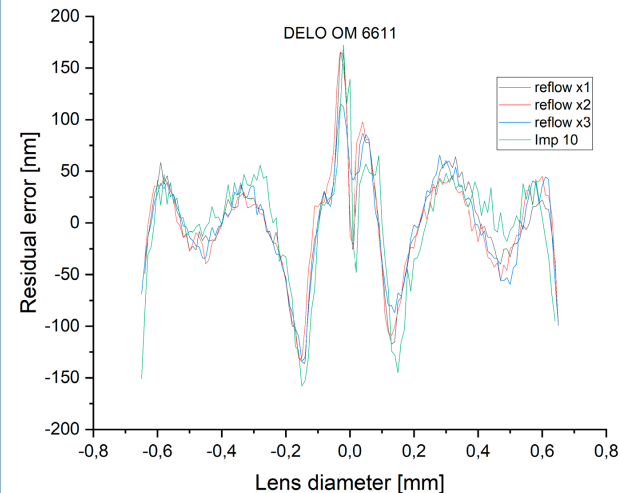
Lens Surface Roughness



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

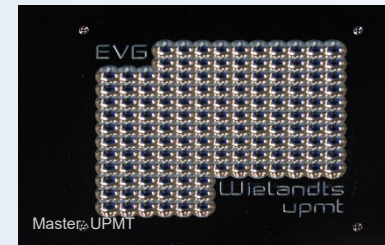
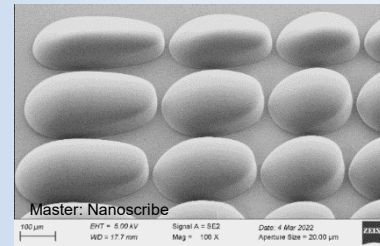
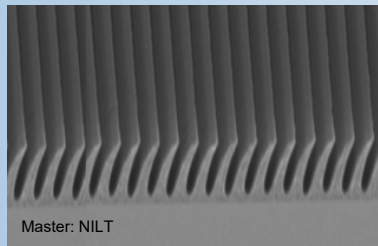
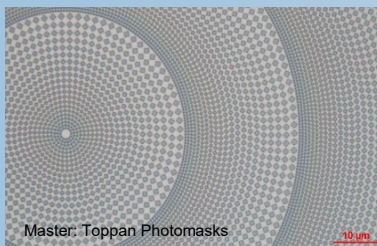
500 nm

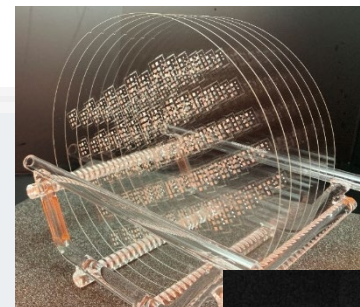
5 μ m

50 μ m

500 μ m

Structures







Full imprinting process in a single system

All Whitepapers →

Master: Toppan Photomasks

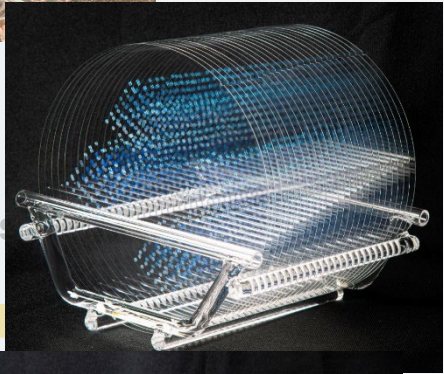
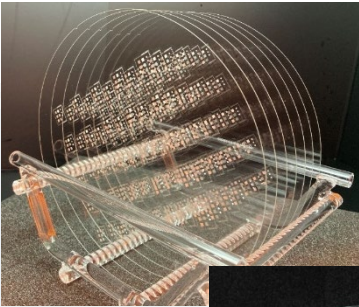
Master: NILT

50 µm

Master: Nanoscribe

BIT = 0.05 µm Signal A = 502 Date: 4 Mar 2024

WD = 17.7 mm Mag = 100 X Aperture Size =



Thank you!

Thomas Achleitner, Business Development Manager



May 2022

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