

EPIC Online Technology Meeting on Freeform Optics for AR/VR

# Nanoimprint Lithography for AR Waveguides Manufacturing

Dr. Martin Eibelhuber, Deputy Business Development

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

Founded in 1980 by DI Erich and Aya Maria Thallner. More than 1000 employees worldwide

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

## Recent Developments



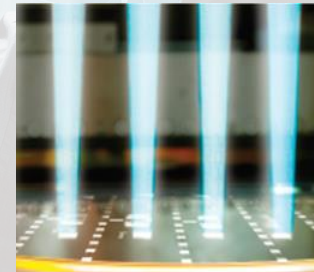
**GEMINI® FB**  
Hybrid Bonding



**EVG®850 DB**  
Laser Debonding



**BONDSCALE™**  
Fusion Bonding



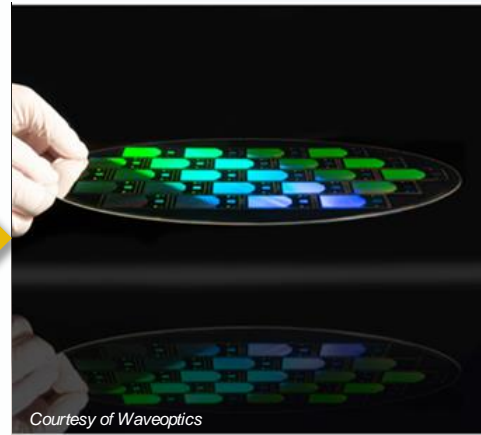
**EVG® MLE™**  
Maskless Exposure  
Technology



**EVG® HERCULES® NIL**  
SmartNIL® UV-NIL  
Up to 300 mm

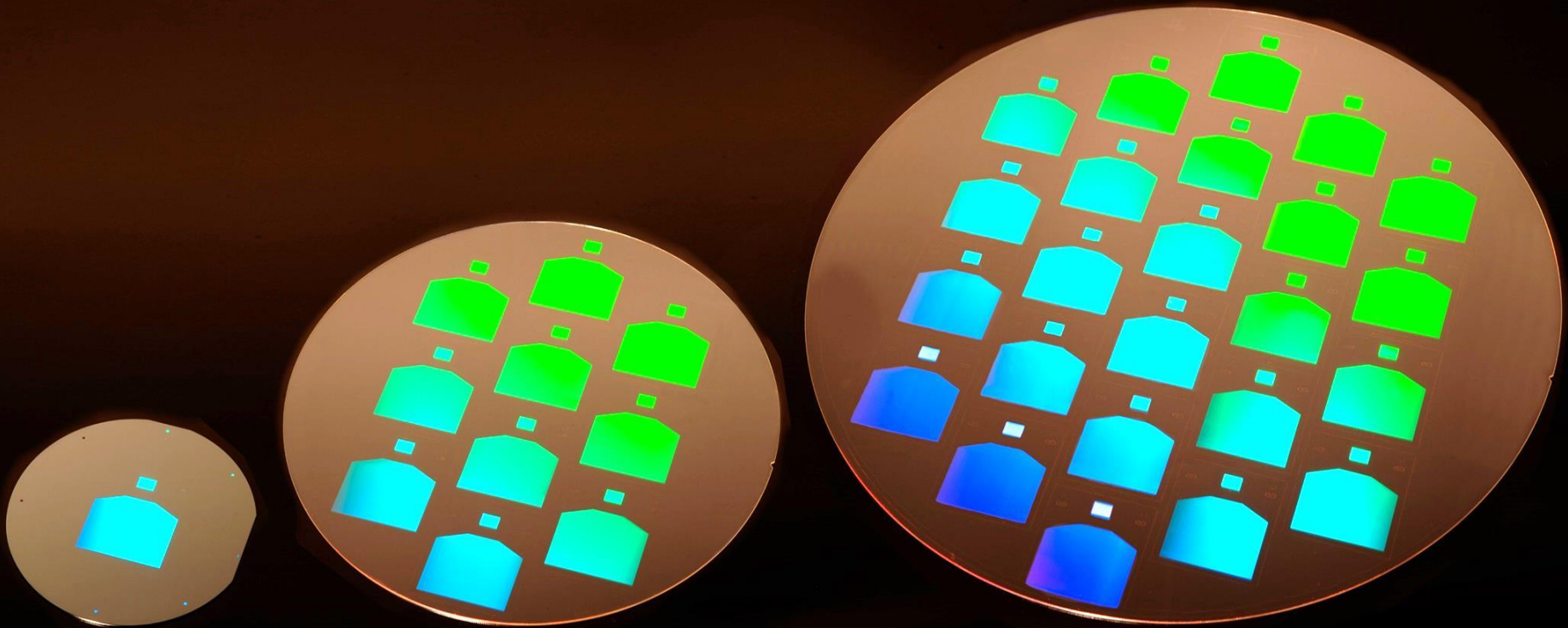
→ World's first fully modular & integrated 300 mm NIL System

SmartNIL Module      Clean Module      Bake Module      Spin Coat Module





# Nanoimprint Lithography | Scaling for High Volume Manufacturing



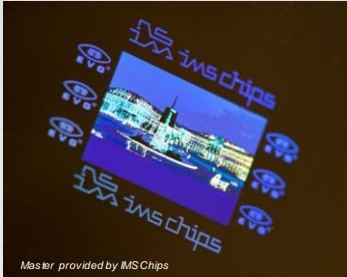
Courtesy of Waveoptics



# Process Flow | Step & Repeat Mastering plus SmartNIL<sup>®</sup> Production



## 150mm Master



## S&R Imprinting

Alignment for imprint on substrate



Imprinting and UV Exposure



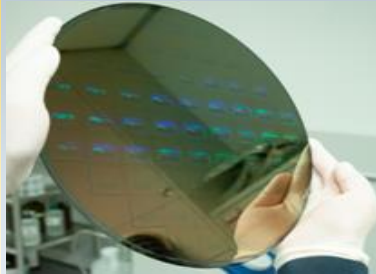
Separation



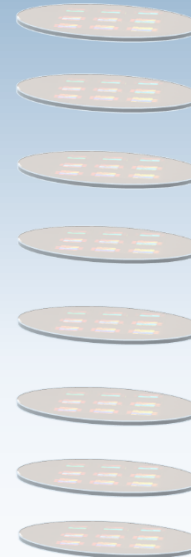
Further S&R Imprinting



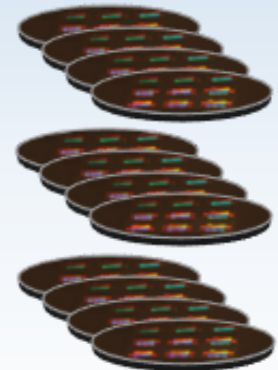
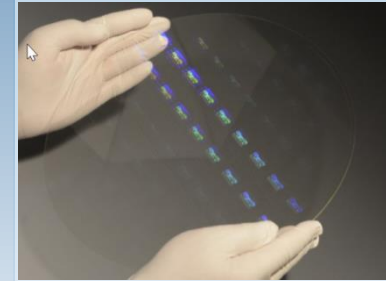
## 200/300mm Master



## Multiple working stamps per master



## Multi imprints per working stamp



→ Made by e-beam lithography, ...

→ Made by EVG770<sup>®</sup> NIL S&R system

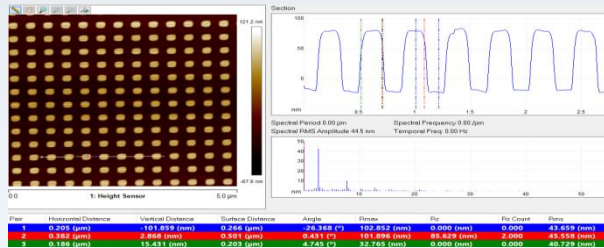
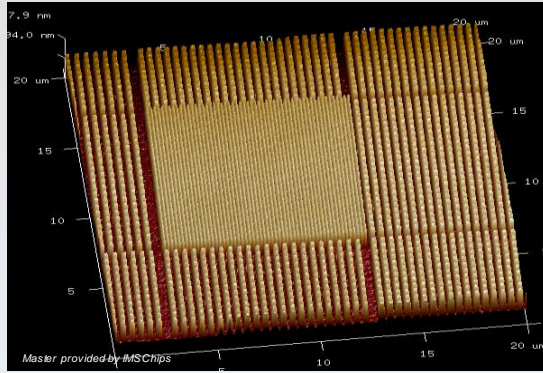
→ Made by EVG770<sup>®</sup> NIL S&R system

→ Made by EVG7200<sup>®</sup> or Hercules NIL

→ Made by EVG7200<sup>®</sup> or Hercules NIL

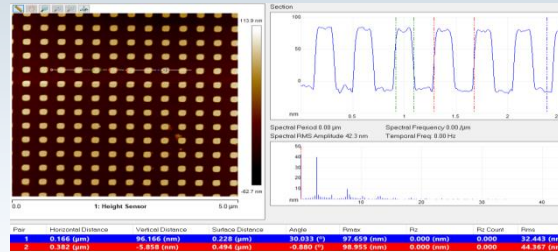
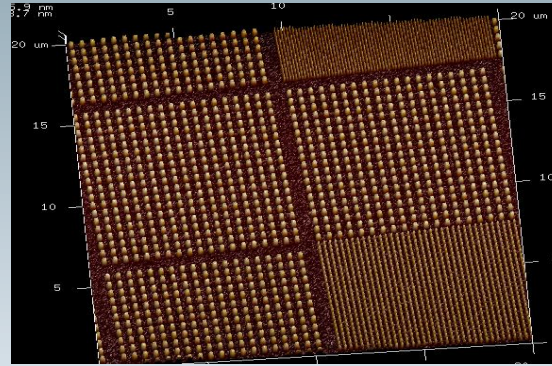


## Master Template



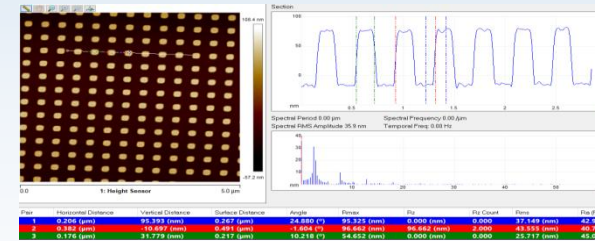
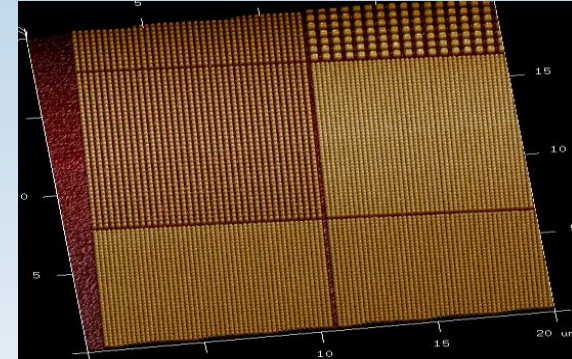
Pillar height: 101nm  
Pillar Diameter: 186nm  
Pitch: 382nm

## Step & Repeat



Pillar height: 96nm  
Pillar Diameter: 176nm  
Pitch: 382nm

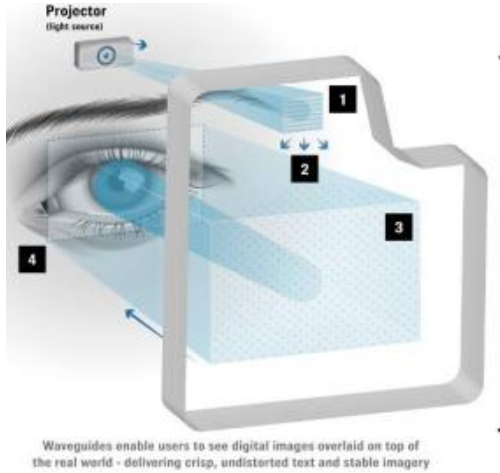
## Final Imprint



Pillar height: 95nm  
Pillar Diameter: 176nm  
Pitch: 382nm

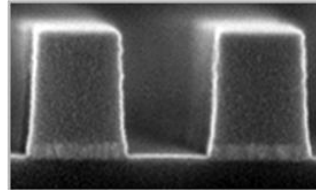


# SmartNIL<sup>®</sup> Results | Waveguides for Augmented Reality



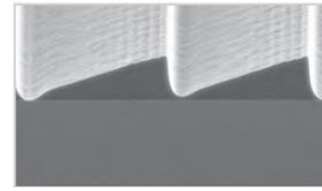
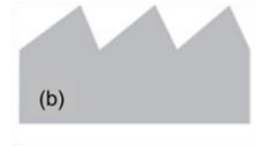
Source: Waveoptics

Binary Grating



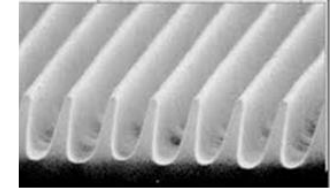
Source: IMS Chips

Blazed Grating



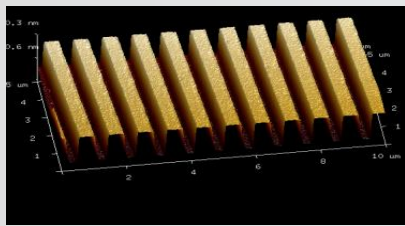
Source: IMS Chips

Slanted Grating

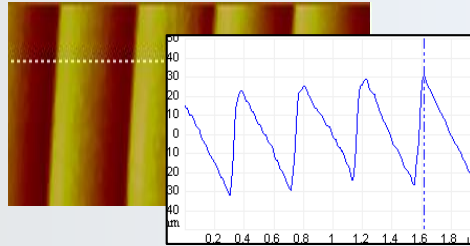


Source: Yole

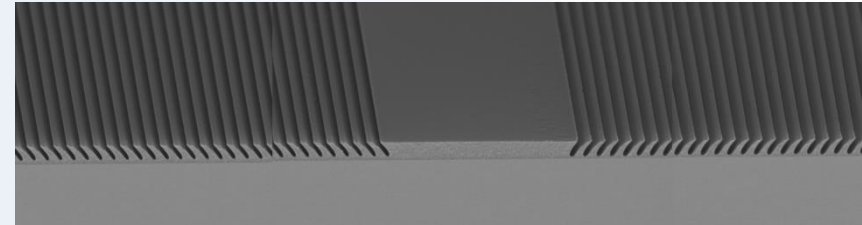
## → SmartNIL Reference Structures



Source: EVG



Source: EVG



Master provided by NILT



# Process Flow | Step & Repeat Mastering plus SmartNIL<sup>®</sup> Production



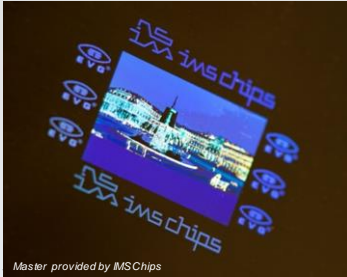
150mm Master

S&R Imprinting

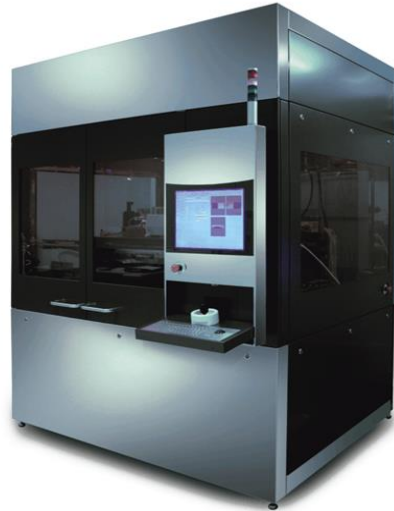
200/300mm Master

Multiple working stamps per master

Multi imprints per working stamp



Master provided by IMSChips



EVG770



EVG Hercules NIL

→ Made by e-beam lithography, ...

→ Made by EVG770<sup>®</sup> NIL S&R system

→ Made by EVG770<sup>®</sup> NIL S&R system

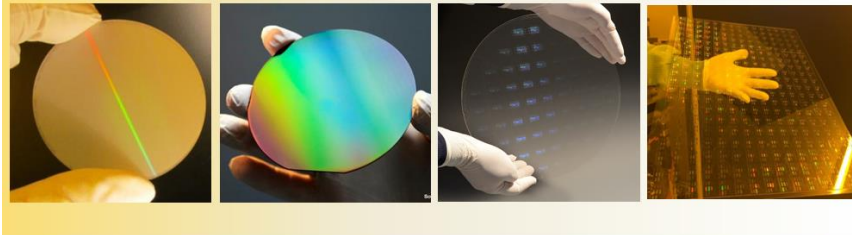
→ Made by EVG7200<sup>®</sup> or Hercules NIL

→ Made by EVG7200<sup>®</sup> or Hercules NIL





# Nanoimprint Lithography | Manufacturing Readiness



## EVG® HERCULES® NIL 300 mm 2019

Fully modular and integrated HVM UV-NIL System



## EVG® HERCULES® NIL 2015

Fully integrated HVM UV-NIL System

## EVG®7200LA 2016

Panel Size Nanoimprint Lithography System



## EVG®7200 2014

Fully automated UV-NIL System 200mm



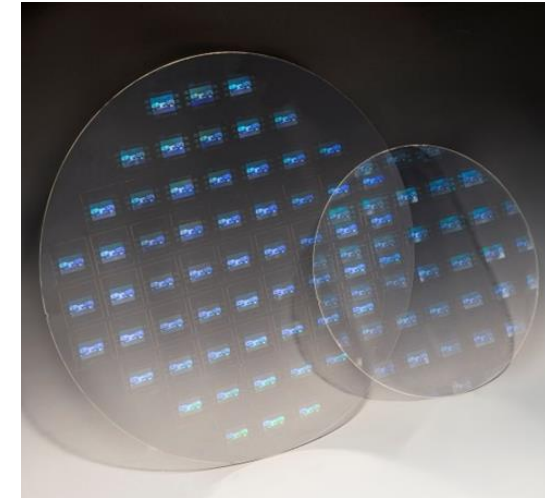
## EVG®720 2013

Fully automated UV-NIL System 150mm



## EVG®620 1997

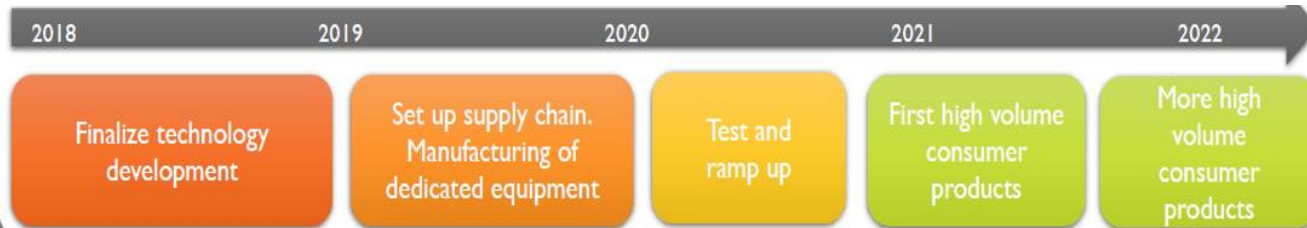
Semi automated UV-NIL



Source: EVG in cooperation with IMS Chips and Schott



Source: Waveoptics



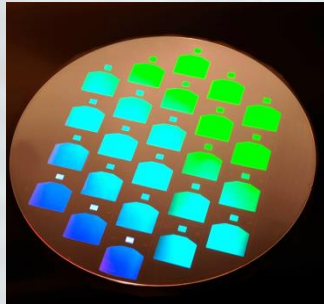
Source: Yole



**NILPhotonics® Competence Center – A smart way to collaborate for success**

**Establish decisive manufacturing steps in close collaboration with process and equipment experts**

**Bridging the gap between photonics R&D and volume manufacturing**



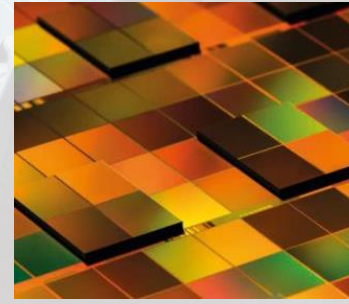
**Nanoimprint & S&R Mastering**



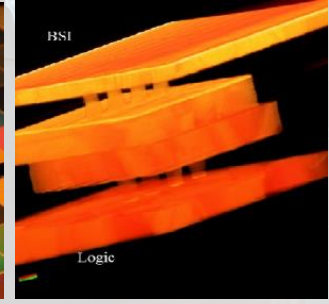
**Wafer Level Optics & Photonics Packaging**



**Advanced Resist Processing**



**Heterogeneous Integration**



**3D Integration & Hybrid Bonding**

# Thank you for your attention.



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Deputy Business Development  
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Web: www.EVGroup.com



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