

# Maximizing sputtering tool requirements of optical interference filters on chips

Sputter deposition tool requirements for production of optical filters on chips

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EPIC Technology Meeting on Microelectronics  
& Photonics – Two Sides of One Coin



13<sup>th</sup> November 2023

# Leybold Optics at a glance

## Leybold Optics Hub – Raleigh, USA

- Vacuum deposition equipment
- Application center
- Spare parts stock

## Center of Competence – Owatonna

- Sputtering Components (End blocks, cathodes etc.)

## Leybold Optics Hub – Alzenau, Germany

- Vacuum deposition equipment
- Application center
- Spare parts stock AM

## Center of Competence Leipzig

- Ion Beam figuring; –trimming
- Automation
- Measurement Technology

## Center of Components Hasselroth


- Technology Components (Plasma source, cathodes etc.)

## Leybold Optics Hub – Beijing, China

- Vacuum deposition equipment
- Application center
- Spare parts stock

  
**250mCHF**  
Turnover

  
**450**  
FTE employees

  
**3500**  
Installed system

  
**7%**  
of turnover for  
innovation



# Business Area Leybold Optics

## Our solutions

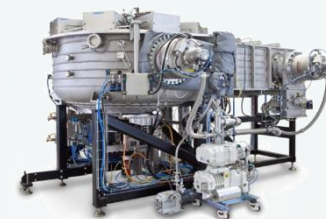
- Vacuum-deposition equipment for optical thin-film coatings for ophthalmic and precision optics, figuring and correction of features on a variety of substrates, metallization of complex parts and large-area coatings for glass and electronics.

## Our customers

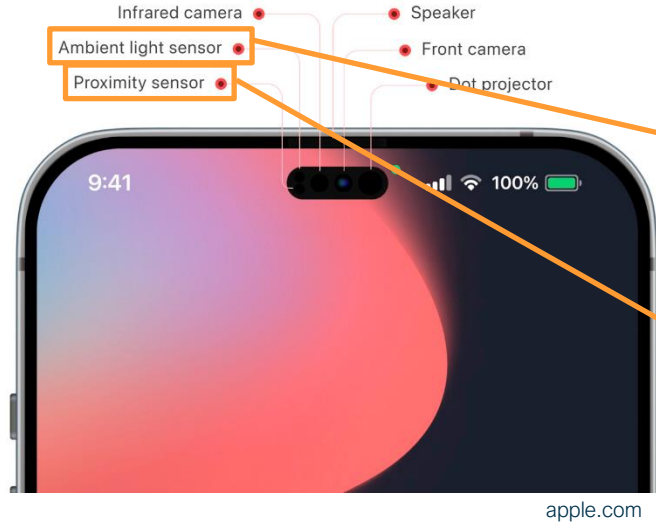
- Global manufacturers of consumer mobile devices and fashion and medical eyeglasses.
- Manufacturers of architectural and automotive glass.

## Key fact

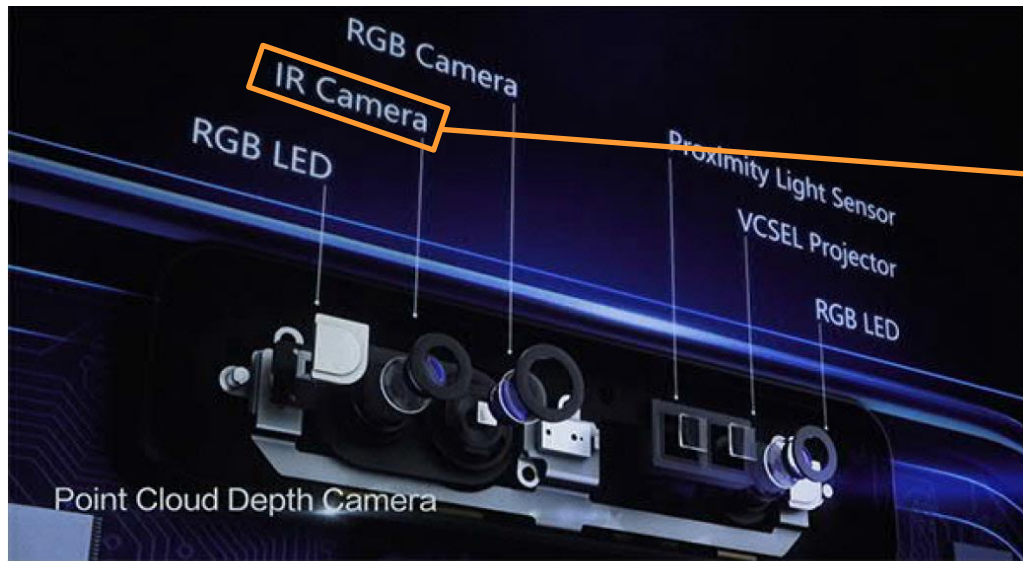
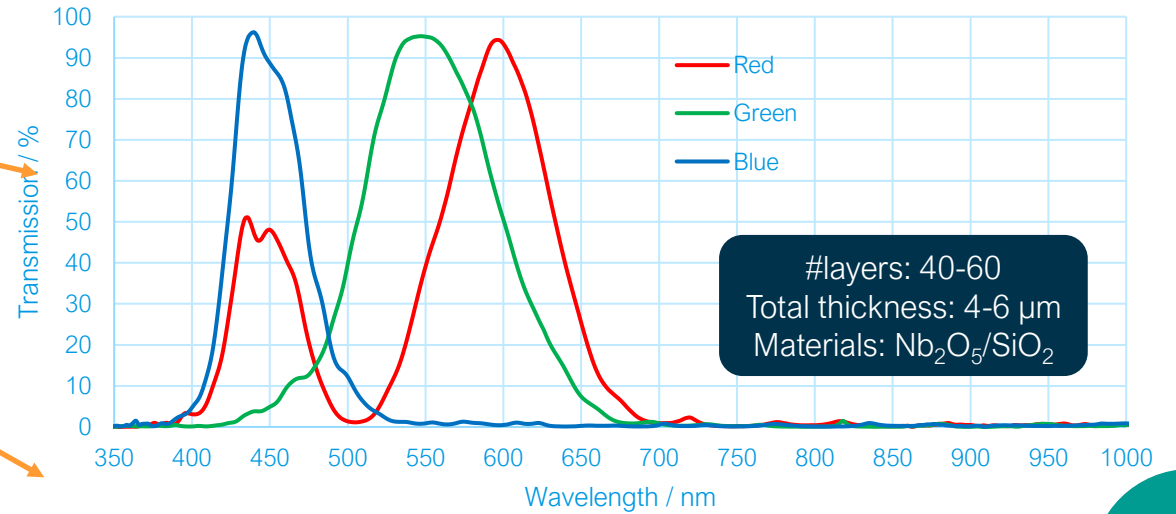
- Buildings with coated architectural glass require up to 30% less energy for heating and cooling.



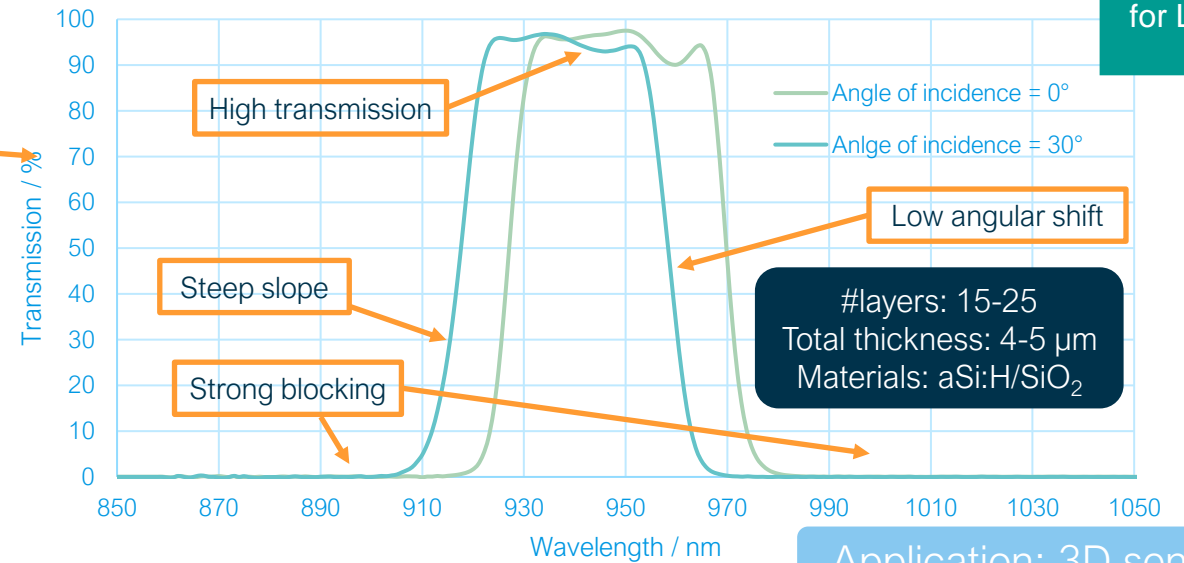
# Emerging Technologies: Sensors in Consumer Electronics



Transmission spectra color filters



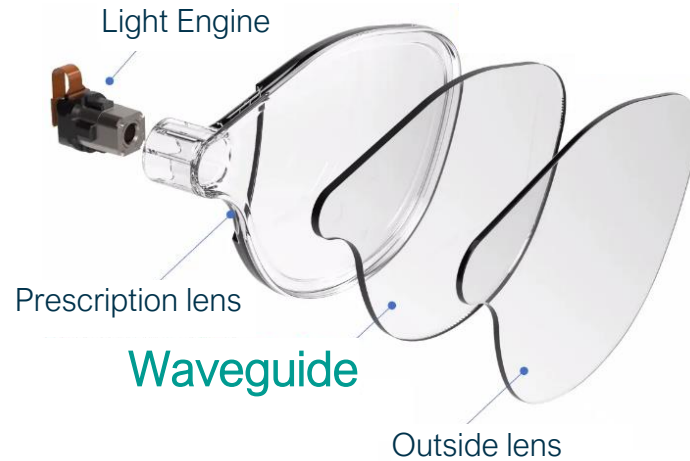
Transmission spectra low angular shift filter



Similar coatings for LIDAR



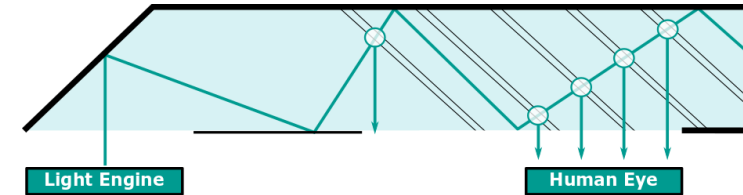
# Emerging Technologies: AR&VR glasses



Source: WaveOptics

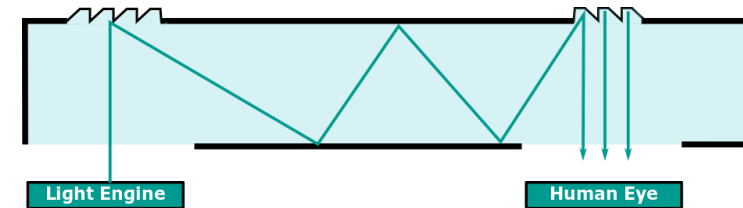
- ✓ Sputtering of waveguide materials
- ✓ High Reflective surfaces
- ✓ Antireflective coatings
- ✓ Transflective Mirrors/Beam Splitters
- ✓ Low loss thick SiN/AlN coating method to replace LPCVD and PECVD – Request for PICs

## Reflective

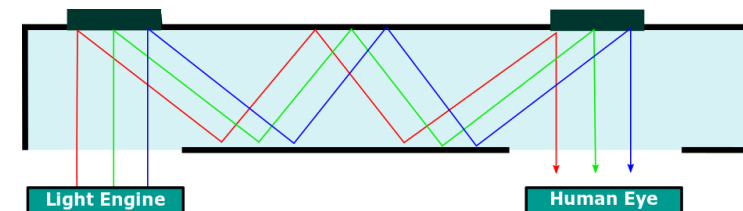


## Diffractive

With Surface Relief Gratings



With Volumetric Holographic Gratings





HELIOS 800 (200mm)

HELIOS 1200 (300mm)

Technology

Filter  
Performance

Particle  
Performance

Automation



# HELIOS Series

HELIOS Series  
Process Capabilities



# HELIOS Series

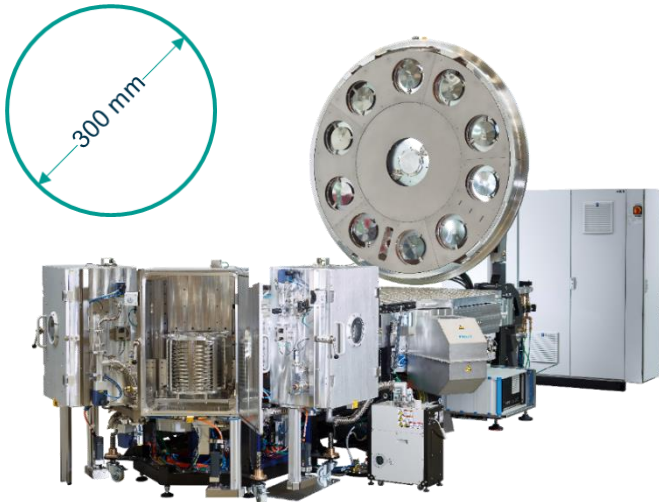
Dedicated for production of complex interference filters directly onto CMOS wafers

## Request from Semiconductor Market.

- In-situ control for highest reproducibility and uniformity
  - <+- 0,5% on 200 mm
  - <+- 0,3% on 300 mm
- High deposition rates
- High material flexibility and target utilization
- Low deposition temperature
- Low particle level
- SEMI certification



HELIOS800



HELIOS1200



# HELIOS Series

Dedicated for production of complex interference filters directly onto CMOS wafers

## Request from Semiconductor Market.

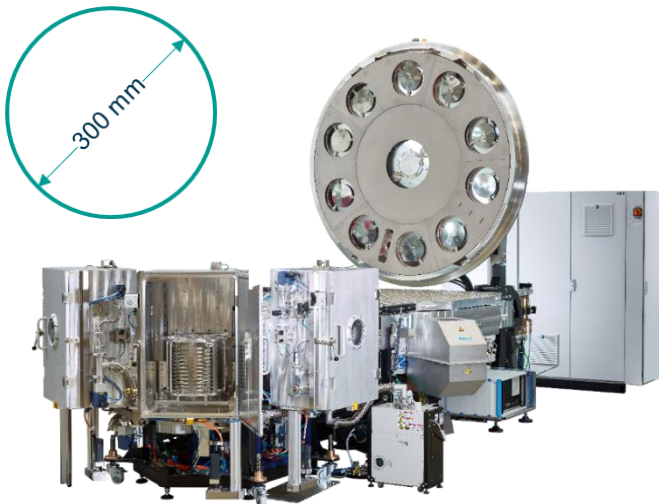
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## Technology.

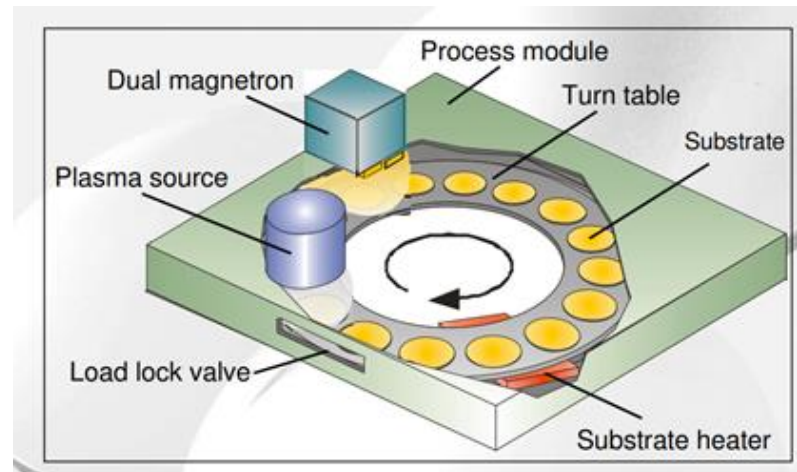
- PARMS+: Plasma Assisted Reactive Magnetron Sputtering



HELIOS800



HELIOS1200



# HELIOS Series

Dedicated for production of complex interference filters directly onto CMOS wafers

## Request from Semiconductor Market.

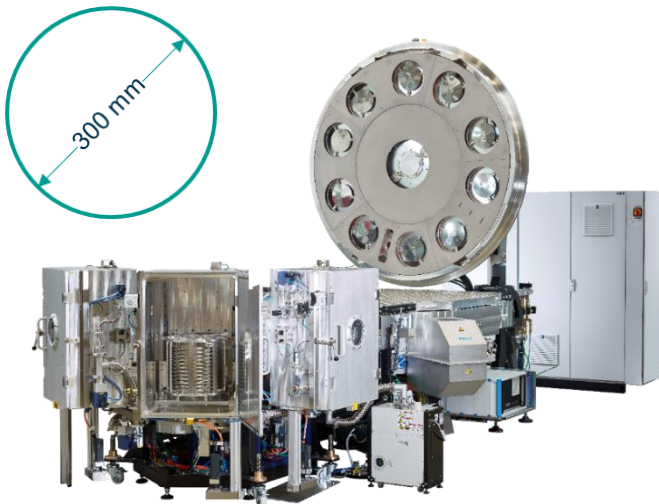
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## Technology.

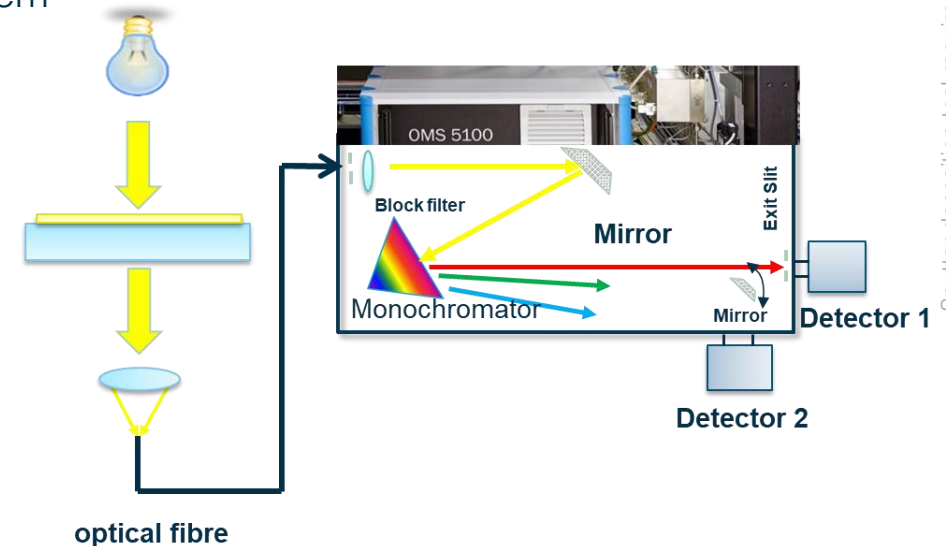
- PARMS+: Plasma Assisted Reactive Magnetron Sputtering
- OMS: Optical Monitoring System



HELIOS800



HELIOS1200





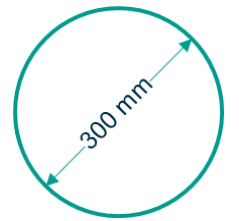
# SiH Bandpass Filter

HELIOS Series  
Process Capabilities



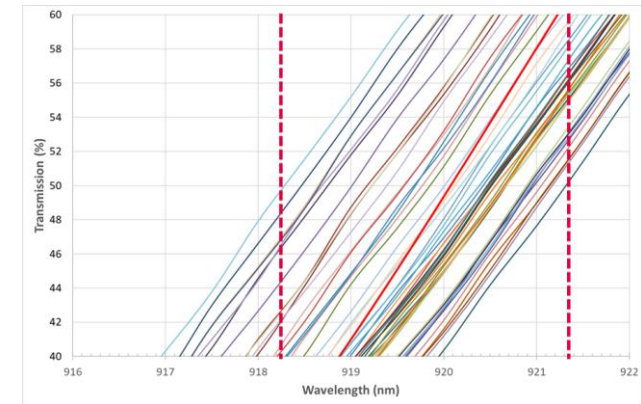
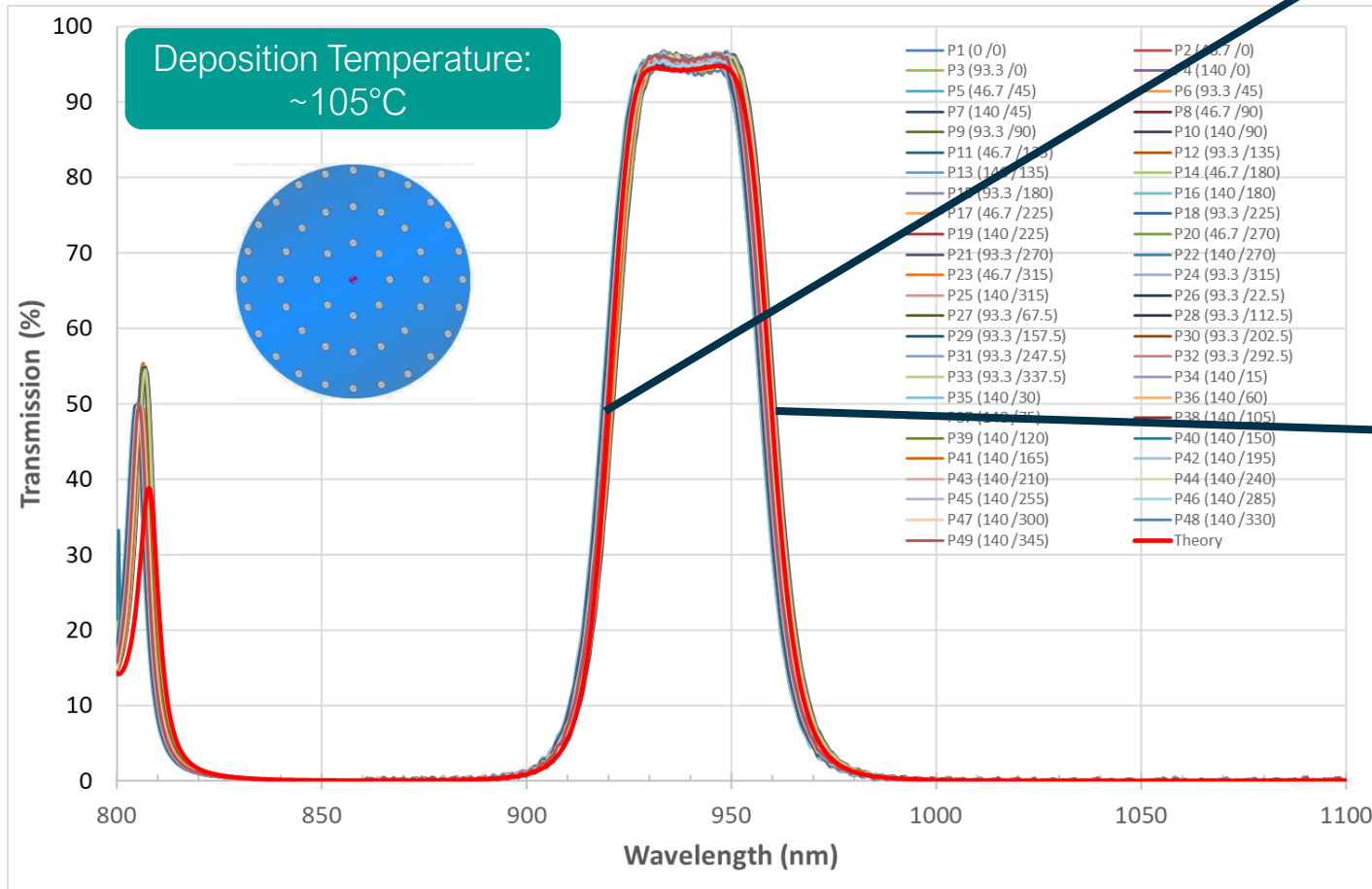
# Bandpass Filter @940nm

## Filter Performance

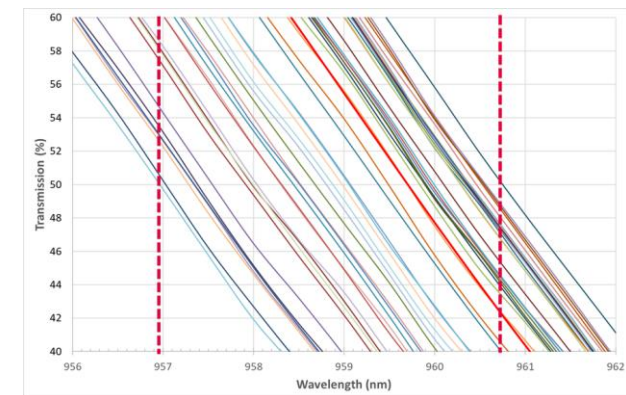


CWL on substrate position is well on target.

3.2 nm distribution @920nm: < +/- 0.2%



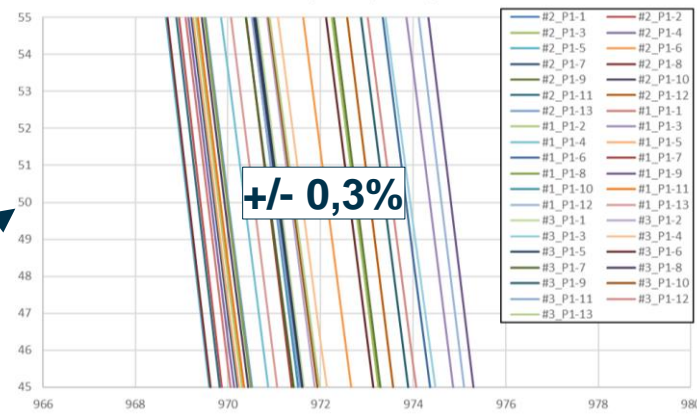
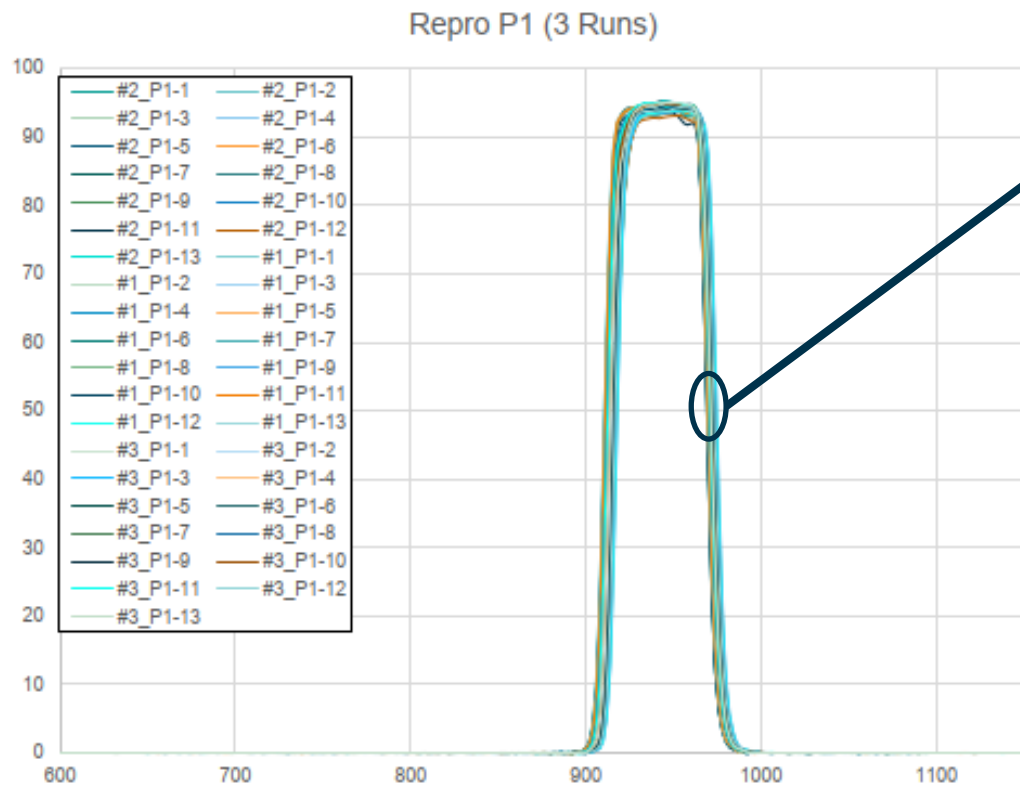
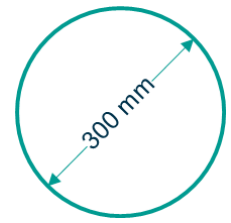
3.8 nm distribution @960nm: < +/- 0.2%



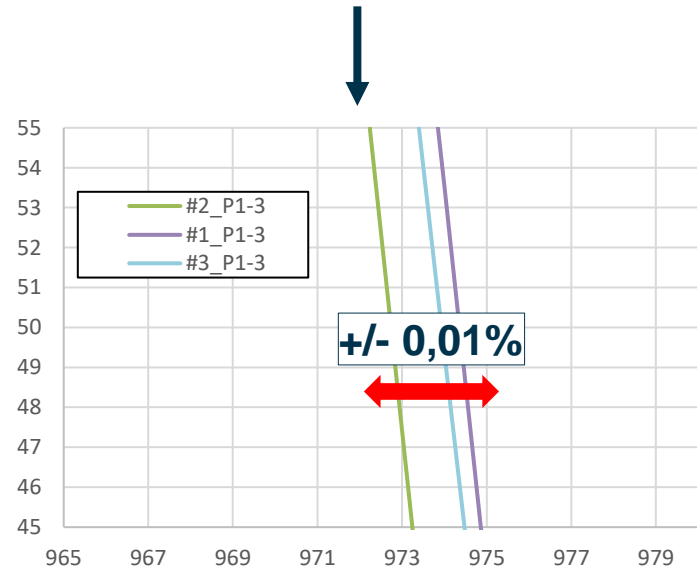


# Bandpass Filter @940nm

## Reproducibility Runs



**R2R**  
3 Runs  
3 Wafer  
39 points



**Single Position**

# Defect Level

HELIOS Series  
Process Capabilities

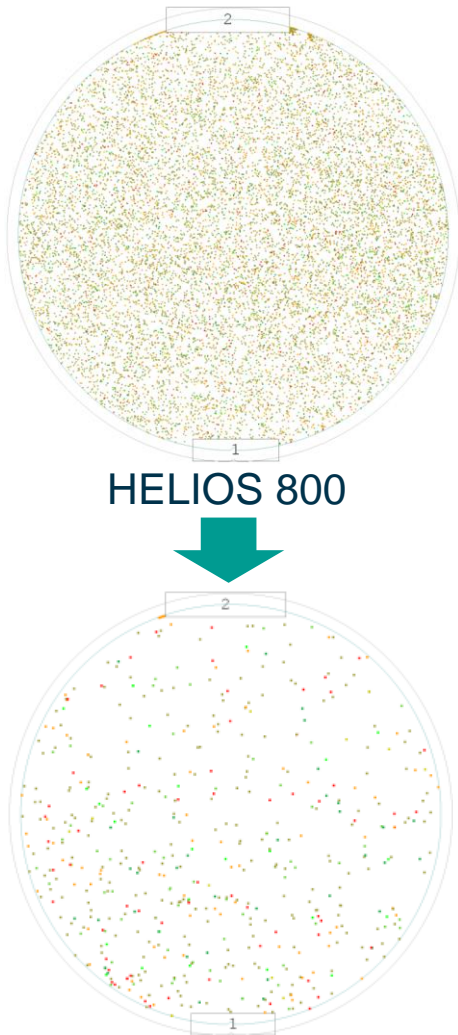




# Particle reduction for HELIOS 800 / Filter coatings SEMI

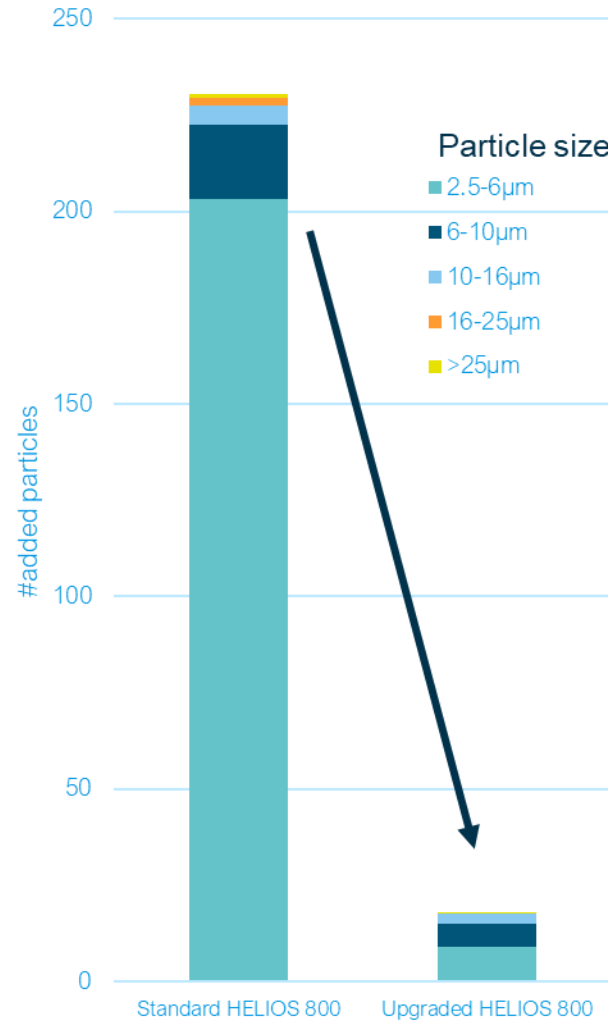
Design: reflector, 6 layers, SiO<sub>2</sub>/Nb<sub>2</sub>O<sub>5</sub>, 600nm

## Particles >0.1µm

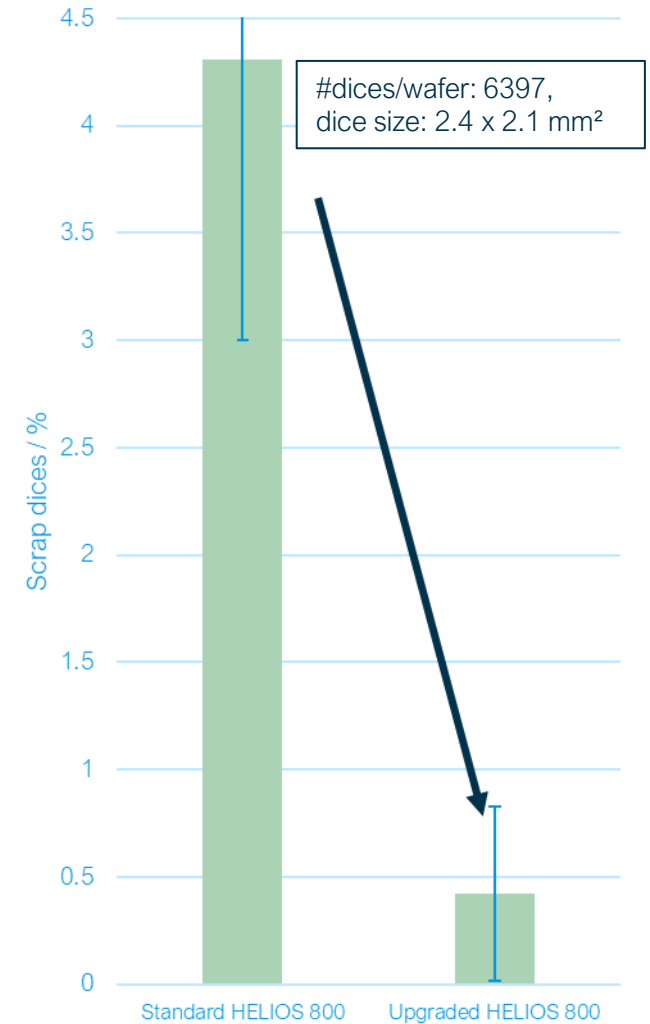


Upgraded HELIOS 800

## Particles >2.5µm



## Scrap level device wafers



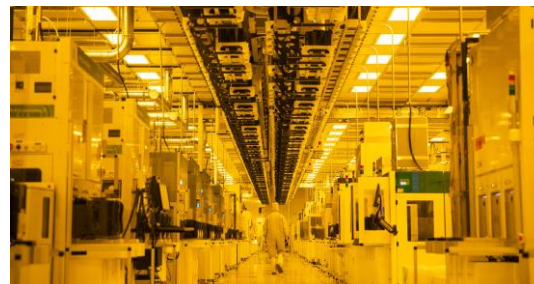
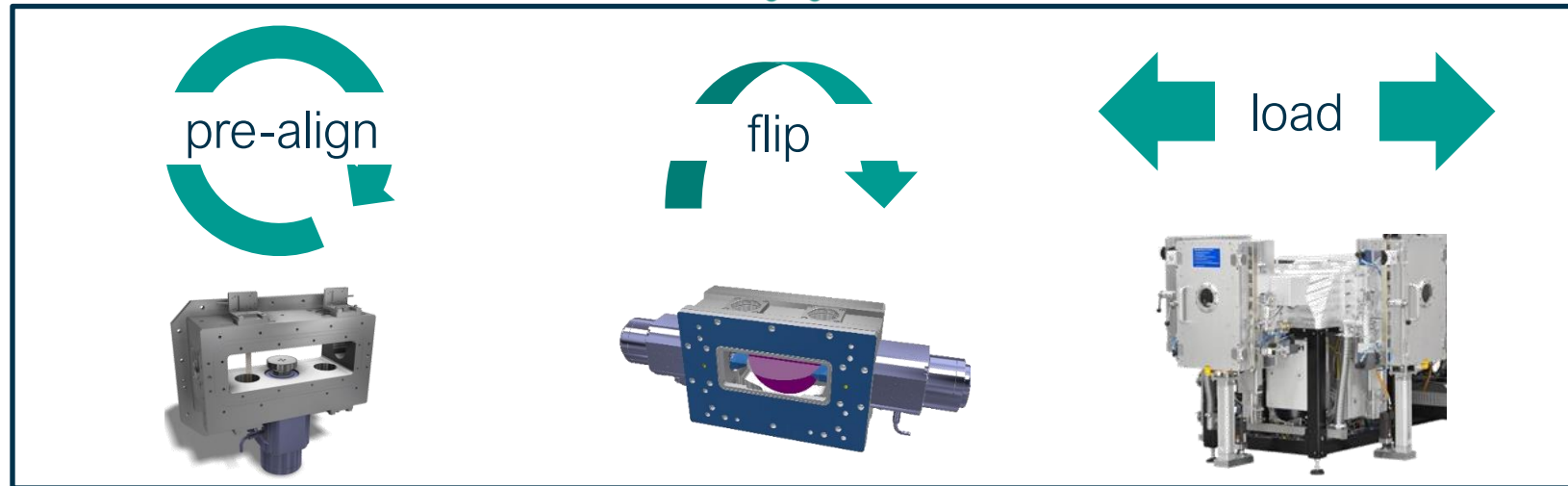
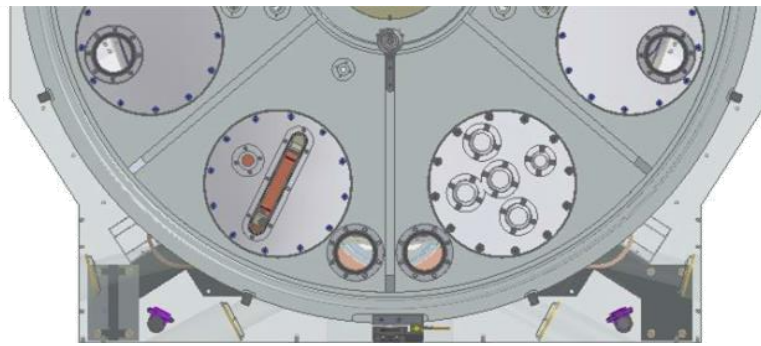
# Wafer Handling

HELIOS Series  
Process Capabilities





# Handling Automation Connection to the fab

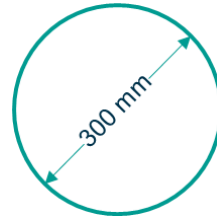


# Handling Automation

## SMIF Direct Loader



1-2 SMIF Load Locks with Auto-door  
Wafer Loading via SMIF pods  
Ready for wafer loading from AGV or OHT



Integration with Equipment Front End Module  
Wafer loading from 1-2 FOUPs  
EFEM Equipped with wafer flipper and wafer aligner







HELIOS 800 (200mm)



HELIOS 1200 (300mm)

## Technology

Well proven technology  
from the Precision Optics  
Market

Upgraded for  
Semiconductor  
Manufacturing

## Filter Performance

Uniformity:  
<+/- 0,4% on 200 mm  
<+/- 0,3% on 300 mm

Low Angle Shift on  
aSiH/SiO<sub>2</sub> NPBF

## Particle Performance

<100 particles sized 0.16  
µm or more

(100 nm thick layers on  
Ø200 mm wafers)

## Automation

From Manual to fully  
Automated Substrate  
Loading Solutions

Integration with SMIF,  
FOUP and EFEM

# Maximizing sputtering tool requirements of optical interference filters on chips

Thank you very much!

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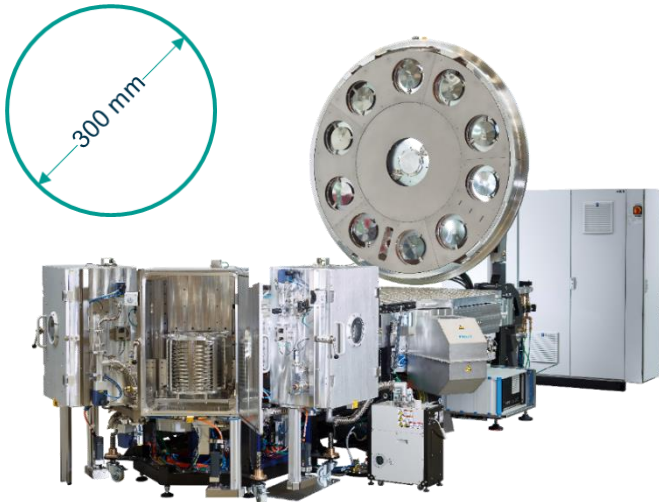
13<sup>th</sup> November 2023



# HELIOS Series



HELIOS800



HELIOS1200

	HELIOS 800	HELIOS 1200
#wafers	11 + 1	10 + 1
Turntable	Standard	Subrotation
Cathodes	Planar	Planar + Rotatable
#PVD stations	3	4
Sputter direction	Down	Up
Coating materials	Ag, Al, Cr, Hf, IGZO, ITO, Mo, Nb, Si, Ta, Ti, Zr, ...	
Process gasses	Ar (sputtering), N2 (nitrides), O2 (oxides), H2 (aSi:H)	
Deposition rates	0.5 nm/s	0.4-0.5 nm/s
Optical Monitoring System	OMS 5100	