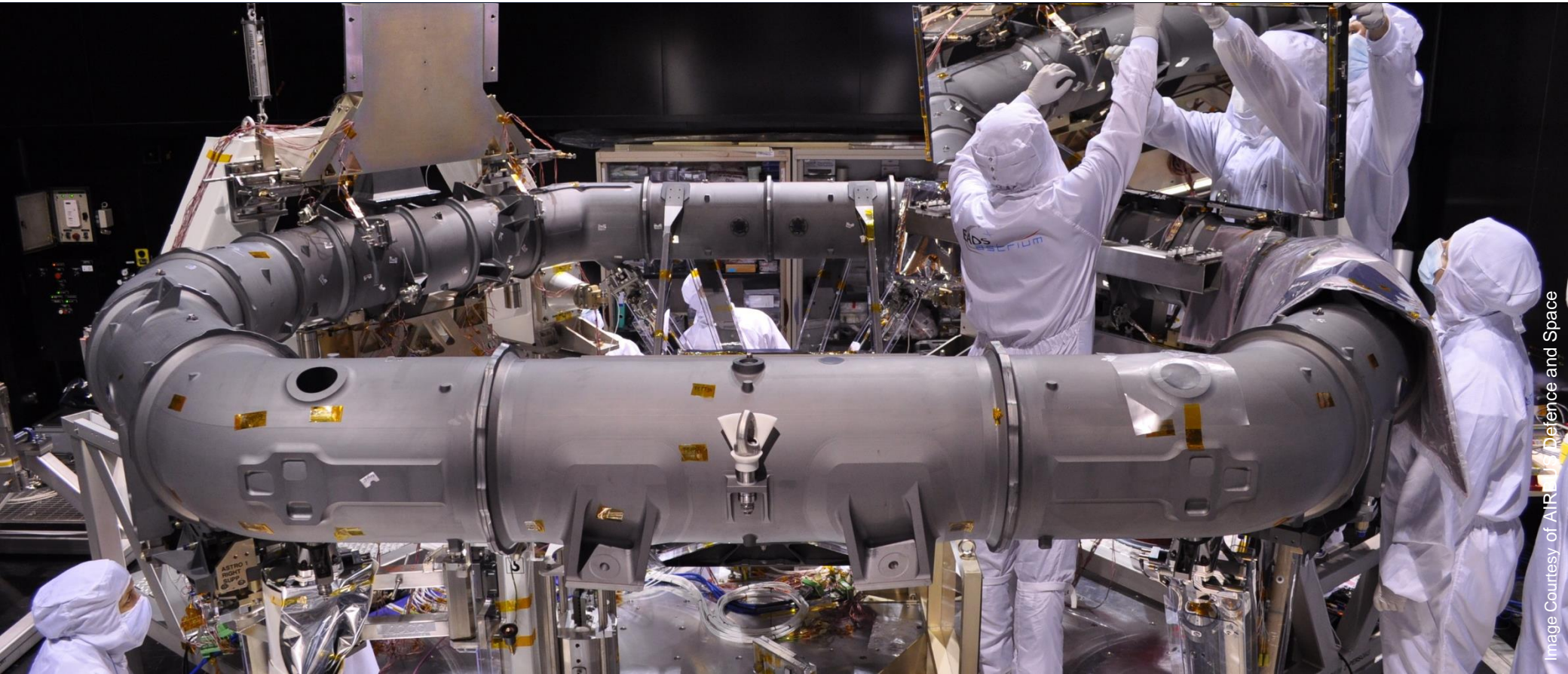


MERSEN BOOSTEC

**MERSEN**  
Expertise, our source of energy

# BOOSTEC<sup>®</sup> SIC

EXCEPTIONAL CERAMICS, SOLUTIONS FOR  
DEMANDING APPLICATIONS





# + Content

- 01** Mersen Boostec Company
- 02** Our SiC Materials
- 03** Boostec<sup>®</sup> SiC Manufacturing Process
- 04** Solutions for ...

# MERSEN BOOSTEC COMPANY



## A «S.A.S.» WITH A CAPITAL OF 3.243 M€ HOLD BY

- Mersen 95.07%
- Airbus Defence & Space 4.93%

## 70 + EMPLOYEES

## LOCATED SOUTH-WEST OF FRANCE

- 1.5 hours drive from Toulouse and Biarritz

## CORE BUSINESS

- Development and manufacturing of SiC hardware for space or ground based optics application

## DIVERSIFICATION

- Development and manufacturing of SiC equipment for applications in the chemical industry, laser processes as well as semiconductor and opto-mechanical OEMs



# OUR SiC MATERIALS

## + Boostec® SiC

- Obtained by pressure-less sintering
- A polycrystalline technical ceramic of  $\alpha$  type
- Completely free of non-combined silicon

## Mersen CVD SiC

- Obtained by Chemical Vapor Deposition
- A polycrystalline technical ceramic of  $\beta$  cubic type
- Highly pure : > 99.999 % SiC
- Theoretically dense :  $3.21 \text{ g.cm}^{-3}$
- Free of voids or micro-cracks, Isotropic and Homogeneous
- CTE matching with the one of Boostec® SiC substrate
- Continuous interface, free from defects
- Successfully used for purpose of masking the residual porosities of Boostec® SiC Mirrors optical faces



# OUR SiC MATERIALS – BOOSTEC® SiC

Thanks to its very high mechanical strength, Boostec® SiC is used not only for making the **mirrors** but also for the **stable structures** and the **focal plane hardware** of the space telescopes



# OUR SiC MATERIALS – BOOSTEC® SiC



- The **very strong covalent Si-C bond** gives Boostec® SiC exceptional physical properties that are particularly reproducible and stable over time
- Unlike glasses, glass-ceramics and oxide ceramics, Boostec® SiC does not present a phenomenon of sub-critical cracking
- Unlike toughened ceramics (Silicon Nitride, stabilized Zirconia), Boostec® SiC shows no sensitivity to mechanical fatigue
- Boostec® SiC mechanical properties (bending strength, modulus of elasticity, toughness) hardly change with temperature, from cryogenic environments close to absolute zero up to 1450°C
- Boostec® SiC is a non-magnetic material
- Boostec® SiC is an excellent radio-frequency (RF) absorber

# BOOSTEC® SiC MANUFACTURING PROCESS

+ Mersen Boostec offers assistance to its customers for the design of their SiC parts to ensure better feasibility, mitigate risks and also reduce costs and lead times



# BOOSTEC® SIC MANUFACTURING PROCESS

## BOOSTEC MANUFACTURING EXPERTISE

From the manufacturing of monolithic ceramics to the production of complex solutions, Mersen Boostec has developed over the years a unique expertise.

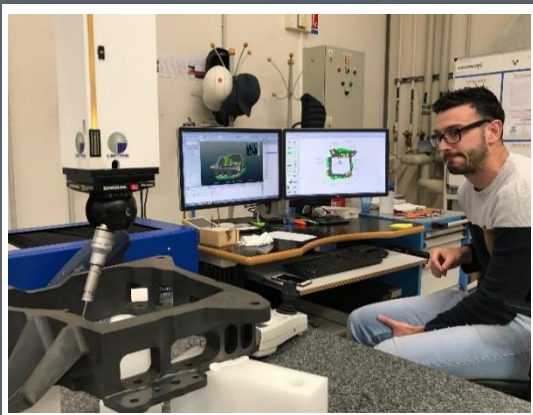
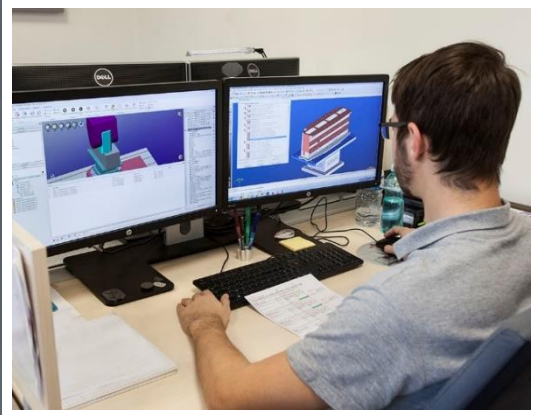
	CAPACITY
MONOLITHIC CERAMICS	Ø 1.30m x 0.60m
	1.65m x 1.30m x 0.60m
CVD SIC COATING	up to Ø 1.50 m
BRAZED SIC/SIC	up to Ø 3.50 m
OPTICAL POLISHING	

	AVAILABLE ASSEMBLIES
OTHER SiC/SiC OR SiC/METAL SOLUTIONS	Epoxy gluing
	Bolting
	Shrink fitting



# BOOSTEC® SIC MANUFACTURING PROCESS



SPACE AND ASTRONOMY

OTHER APPLICATIONS

LASER PROCESSES

**Boostec® SiC**  
SOLUTIONS FOR ...

HEAT EXCHANGERS  
FOR THE CHEMICAL  
INDUSTRY

SEMICONDUCTOR AND  
OPTO-MECHANICS  
OEMS

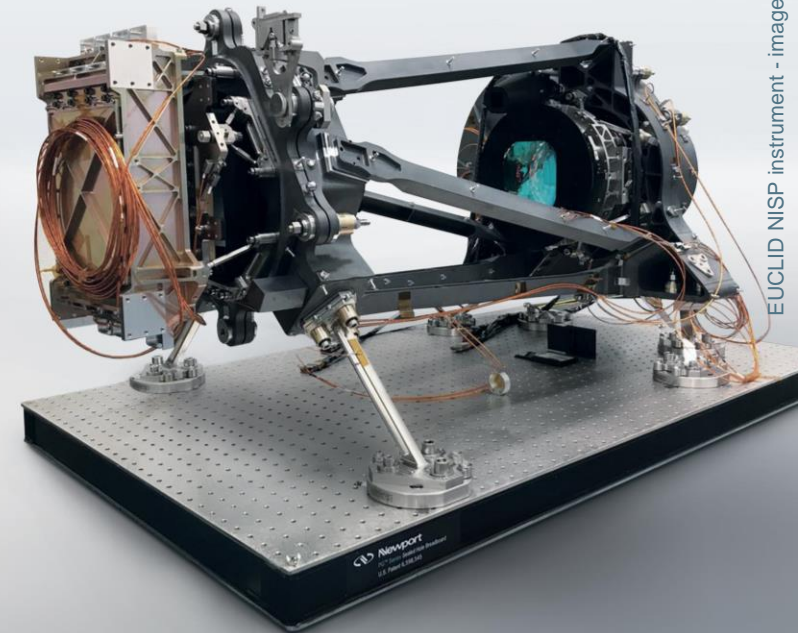
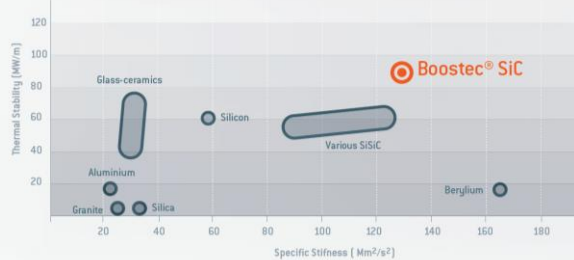
CONTINUOUS FLOW  
REACTORS FOR THE  
CHEMICAL INDUSTRY

# SOLUTIONS FOR SPACE AND ASTRONOMY

- + SPACE AND ASTRONOMY REQUEST MECHANICAL AND THERMAL ULTRA-STABLE OPTICS
- + MERSEN BOOSTEC PROVIDES SiC MIRRORS, SiC STABLE STRUCTURES AND ALSO FOCAL PLANE HARDWARE FOR TELESCOPES TO BE USED IN SPACE OR ON GROUND
- + WITH ITS AIRBUS DEFENCE AND SPACE PARTNERSHIP, MERSEN BOOSTEC IS THE WORLD LEADER FOR SiC SPACE OPTICS

Qualification for space applications down to 30K

No degradation by space radiations



EUCLID NISP instrument - image courtesy of LAM

20 Full-SiC telescopes made of Boostec® SiC are operating in space



# SOLUTIONS FOR SPACE AND ASTRONOMY OUR SUCCESSES



## SPACE

INSTITUTIONAL  
SCIENCES OF  
THE UNIVERSE

NAC Osiris - ROSETTA

HERSCHEL telescope

NIRSpec - JWST

GAIA

EUCLID (telescope + VIS &  
NISP instruments)



Full-SiC EUCLID's very large  
telescope (Ø 1,2m pupil)

Image courtesy of Airbus Defence and Space

# SOLUTIONS FOR SPACE AND ASTRONOMY OUR SUCCESSES



## SPACE

INSTITUTIONAL EARTH  
OBSERVATION

Aladin - AEOLUS (Lidar)

PLEIADES Focal Planes

Sentinel 2A & 2B MSI

ATLID EarthCare (Lidar)

CSO Focal Planes

Sentinel 2C & 2D MSI

IASI-NG FM1-FM2-FM3

MICROCARB

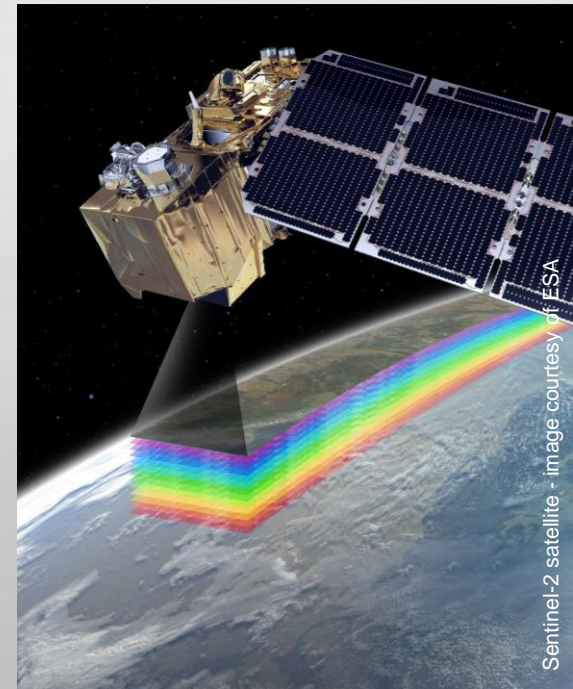
METimage derotator



Aladin-AEOLUS telescope - image courtesy of AIRBUS Defence and Space



Main structure of Sentinel-2 Multi-Spectral Instrument



Sentinel-2 satellite - image courtesy of ESA



# SOLUTIONS FOR SPACE AND ASTRONOMY OUR SUCCESSES



## SPACE

EXPORT EARTH  
OBSERVATION

FORMOSAT-2 (Taiwan)

THEOS I (Thailand)

GOCI-COMS (Korea)

ALSAT 2A & 2B (Algeria)

SSOT FASat Charlie (Chile)

KazEOSat-1 (Kazakhstan)

VNRED Sat-1 (Vietnam)

PERUSat-1 (Peru)

GOCI II KOMPSat-2B (Korea)

THEOS II (Thailand)

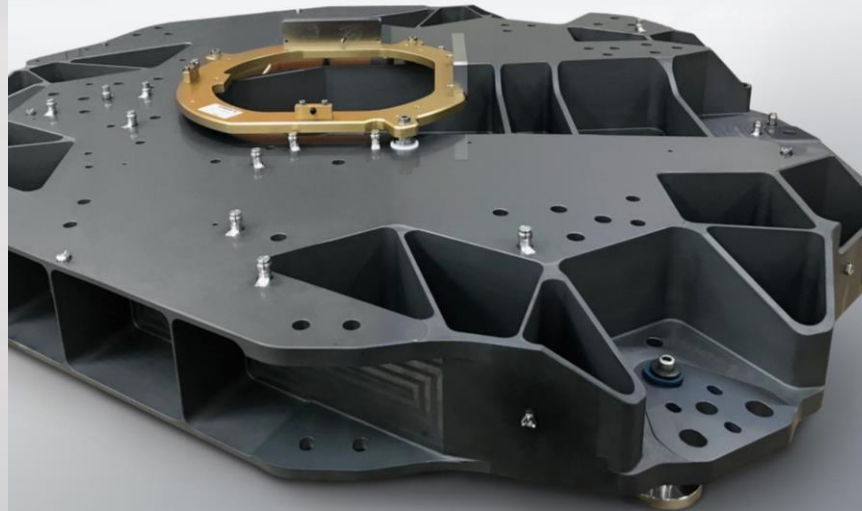


Image courtesy of AIRBUS Defence and Space



Image courtesy of AIRBUS Defence and Space

# SOLUTIONS FOR SPACE AND ASTRONOMY OUR SUCCESSES

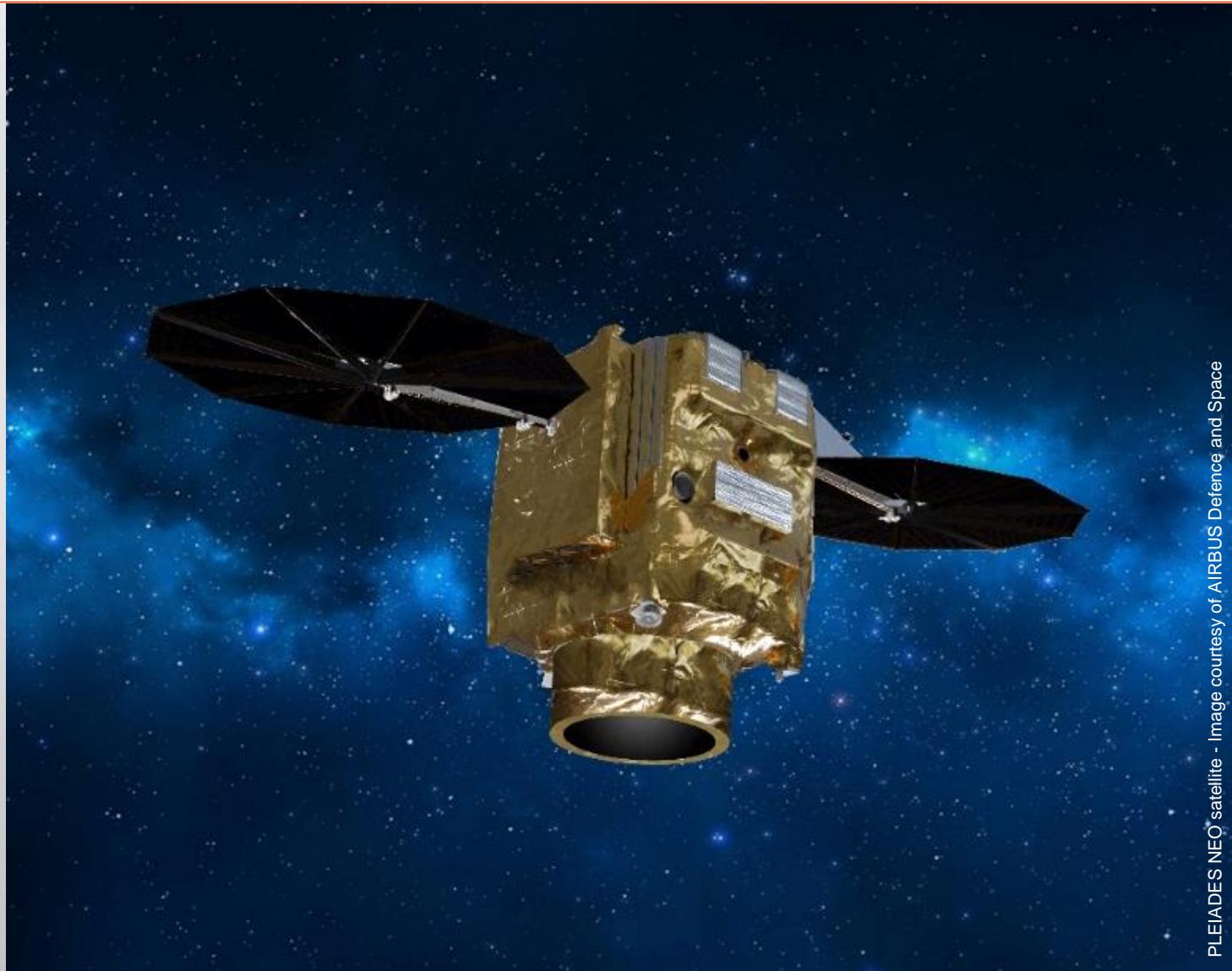


## SPACE

AIRBUS IMAGES  
SALES

SPOT 6 & SPOT 7  
(4 telescopes)

PLEIADES NEO  
4 telescopes  
embarked on 4  
satellites – 30cm  
resolution



PLEIADES NEO satellite - Image courtesy of AIRBUS Defence and Space



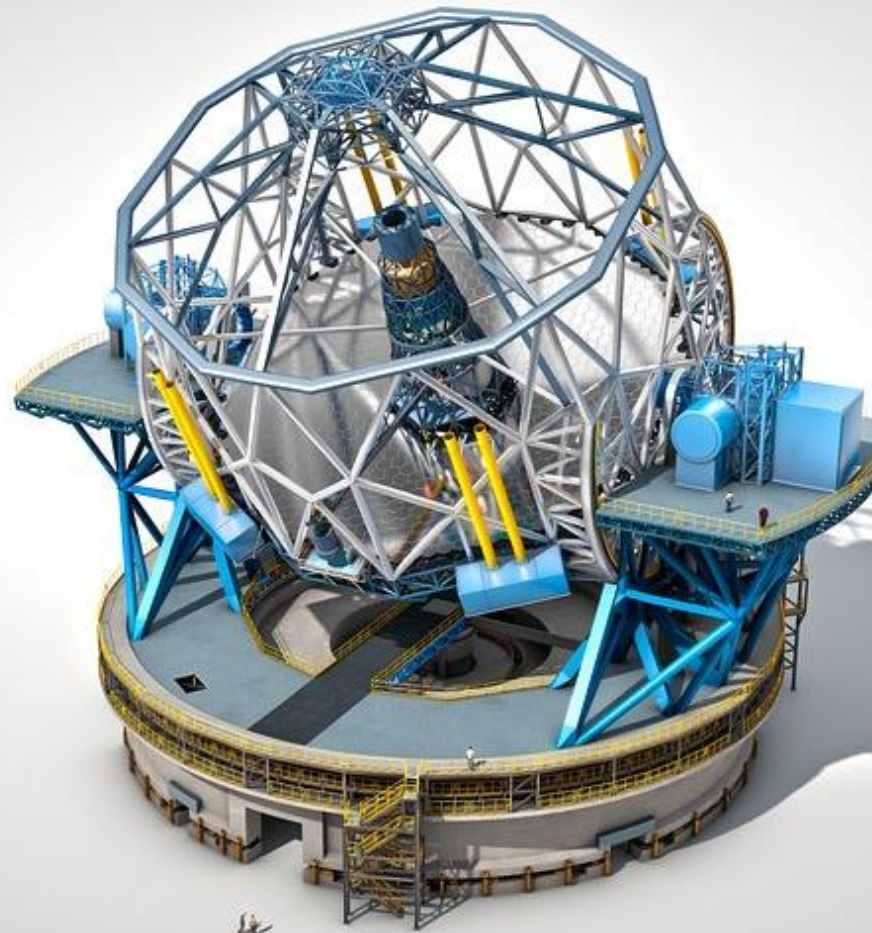
# SOLUTIONS FOR SPACE AND ASTRONOMY OUR SUCCESSES



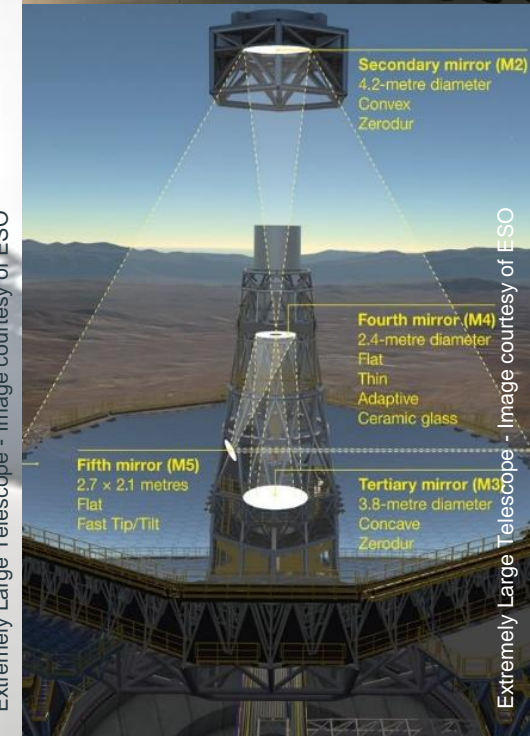
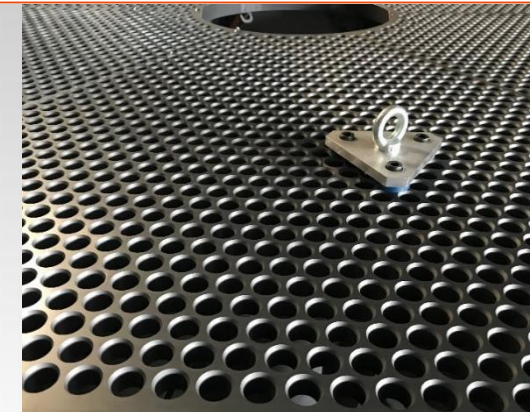
## ASTRONOMY FROM GROUND

ELT M4  
Reaction Body

ELT M5 mirror



Extremely Large Telescope - Image courtesy of ESO



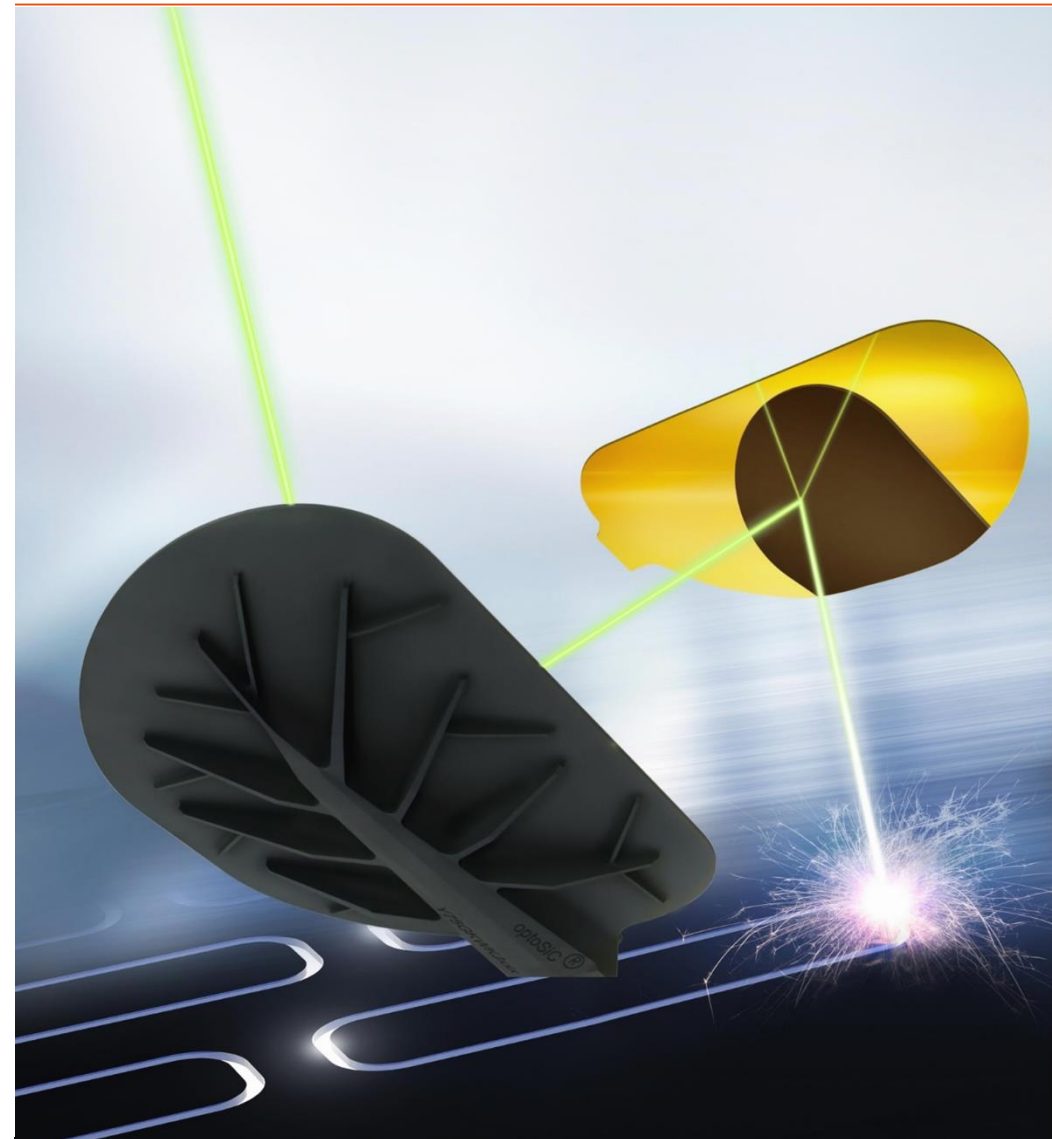
Extremely Large Telescope - Image courtesy of ESO

# SOLUTIONS FOR LASER PROCESSES



MERSEN BOOSTEC PROVIDES STANDARD AND CUSTOM ACTIVE MIRRORS from 500mm apertures, with a range of high reflective coatings. In particular, standard generic XY laser galvo-scanning mirrors from 10 to 100mm aperture are provided in pairs. Glued mounts are also proposed for all standard shaft sizes.

These products are distributed under the trademark optoSiC®



# SOLUTIONS FOR LASER PROCESSES



## KEY ADVANTAGE OF OPTOSIC® OPTICS

- Low moment of inertia, Lightweight
- Low dynamic flatness peak-to-valley (PV)
- High resonance frequency
- Fast thermal stabilization
- Integrated mechanical fasteners
- Standard and custom designs
- Corrosion and wear resistant
- Optically finished to state of the art surface specifications
- Customized coating service





# SOLUTIONS FOR LASER PROCESSES

## + MARKET SEGMENTS FOR OPTOSIC® HIGH-END SCANNING MIRRORS

### Laser for material processing

- Welding
- Cutting, Drilling
- Marking, Microlithography
- Additive manufacturing

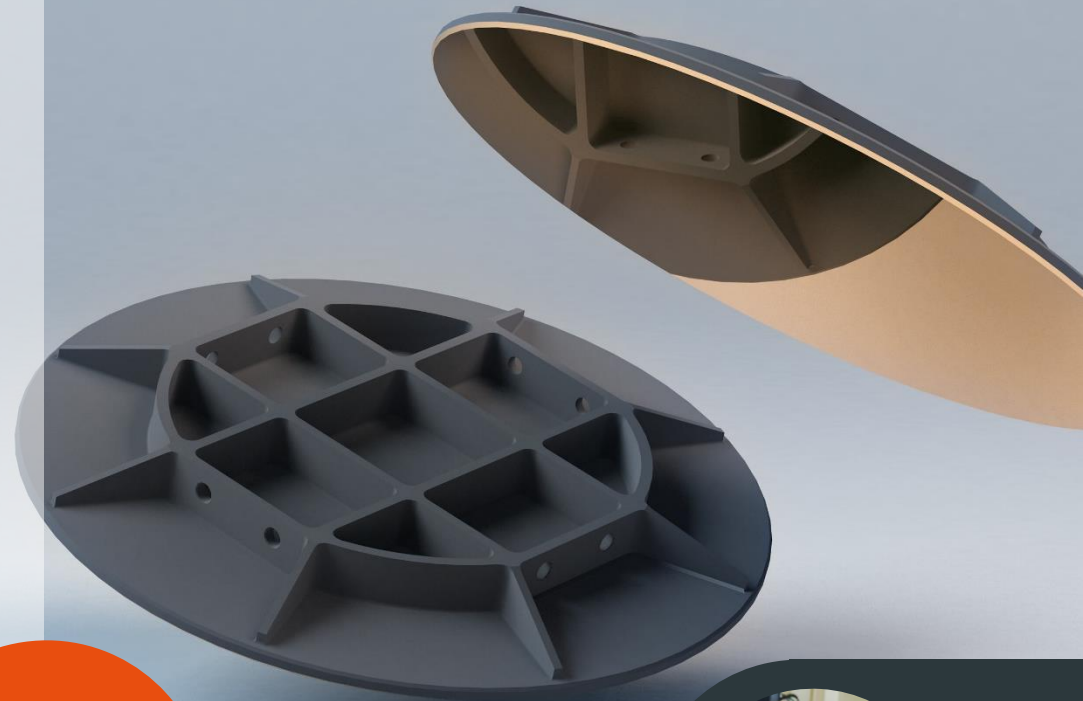
### Laser for instrumentation

- Tracker systems
- Scanner systems, Lidars
- Military application
- Imaging, Laser show

### Laser for medical application

- Biomedical (ophthalmology)

SiC replaces Beryllium whose toxicity problems are wellknown



# SOLUTIONS FOR SEMICONDUCTOR & OPTO-MECHANICS OEMs



MERSEN BOOSTEC PROVIDES THE  
SIC ULTRA-STABLE STRUCTURES  
THAT ARE NOW REQUIRED BY THE  
SEMICONDUCTOR AND  
OPTOMECHANICAL EQUIPMENT

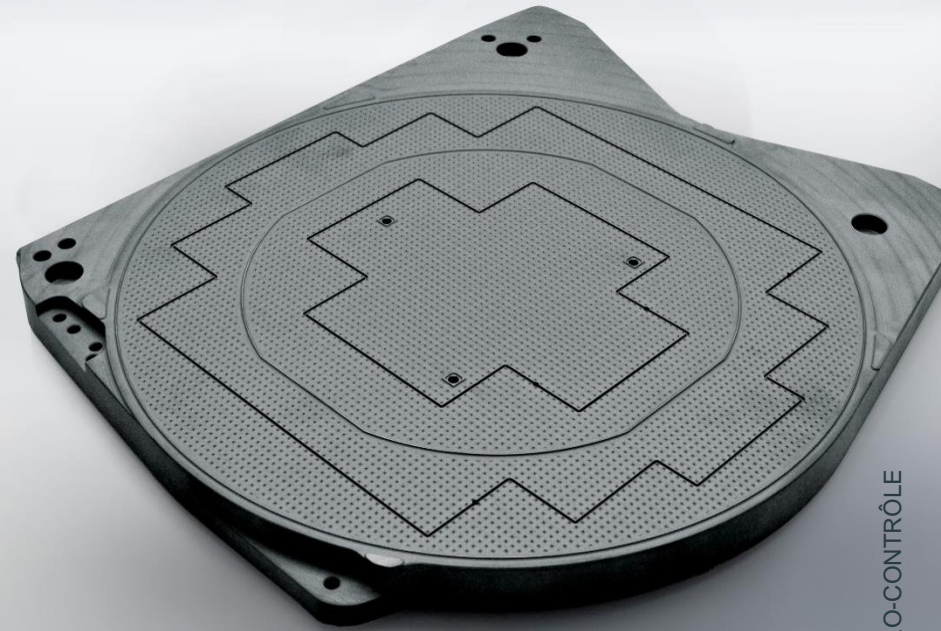


Image courtesy of MICRO-CONTRÔLE

# SOLUTIONS FOR SEMICONDUCTOR & OPTO-MECHANICS OEMs



## KEY ADVANTAGE OF BOOSTEC® SiC

- High specific stiffness and thermal stability
- High mechanical strength and absence of mechanical fatigue
- Perfect isotropy of the SiC material
- Flawless polishable finish which can be used as optical reference
- Perfect stability over time
- Water and gas tight, no outgassing, no moisture absorption
- Wear resistance
- Non-magnetic
- Excellent chemical inertia



Image courtesy of MICRO-CONTRÔLE

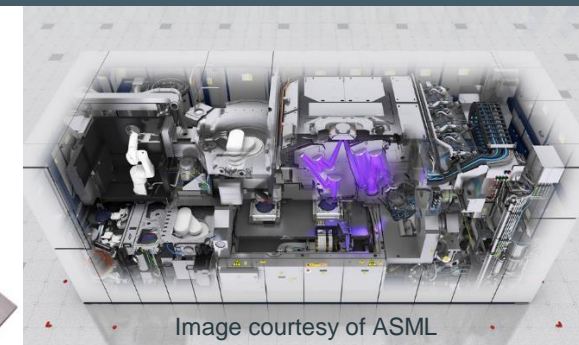
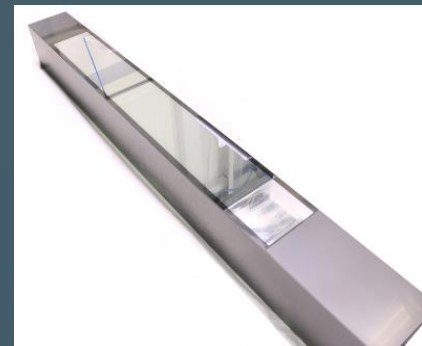
# SOLUTIONS FOR SEMICONDUCTOR & OPTO-MECHANICS OEMs

## + EXPERTISE IN MANUFACTURING & DESIGN

- Unique experience in manufacturing 3-meter class ultra-stables structures
- Possibility of integrated solution on a single part: air bearing system, cooling with internal channels, mirror
- From monolithic SiC part to possibly complex assemblies, Mersen Boostec manufactures highly stable benches, baseplates, beams, sliding structures for fast and accurate positioning, chucks

## BOOSTEC® SiC SOLUTIONS ARE USED WHERE ULTRA-PRECISION IS REQUIRED

- Semiconductor industry processes
- EUV (10-15nm) lithography machines
- Advanced measuring instruments for optical surfaces
- Ultra-high vacuum
- Scientific equipment

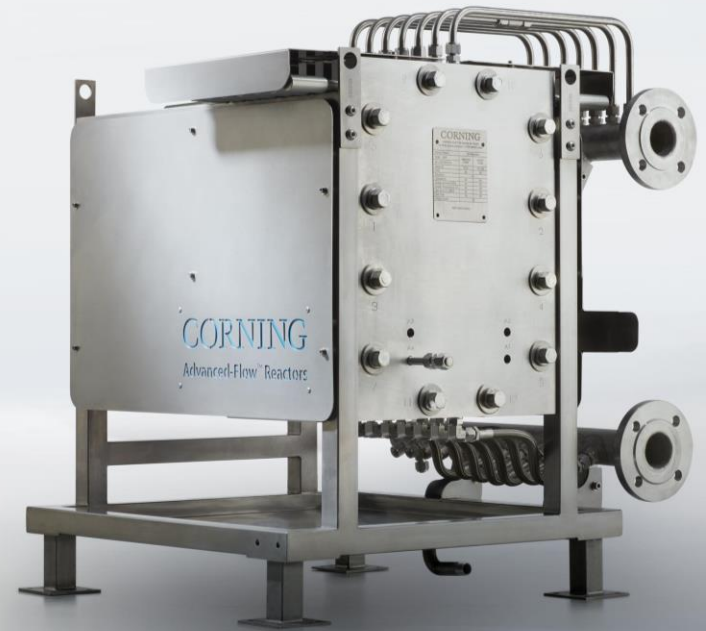


# SOLUTIONS FOR CONTINUOUS FLOW REACTORS



**SIC MODULES FOR CONTINUOUS FLOW REACTOR** IS A TECHNOLOGICAL BREAKTHROUGH IN THE CHEMICAL INDUSTRY

Developed in strong partnership with **CORNING AFR**



CORNING G4 reactor - Image courtesy of CORNING SAS



# SOLUTIONS FOR CONTINUOUS FLOW REACTORS



## KEY BENEFIT

- 100x better mixing
- 1000x higher volumetric heat transfer
- 1000x less material inventory
- Smaller footprint
- Increased safety
- Cost competitive solution

## Technical specifications

- ✓ Scaled-up process from G1 to G5 reactor
- ✓ From 80t/y to 10000t/y
- ✓ Temperature -60°C to 200°C
- ✓ Pressure up to 18 bar
- ✓ Options: ATEX certifications, FDA, CGMP compliance, ASME, SELO...



# SOLUTIONS FOR HEAT EXCHANGERS

**+** **SIC HEAT EXCHANGERS IS A KEY SOLUTION FOR PROCESSES WITH HIGH CORROSION AND HIGH SERVICE RATES (LESS MAINTENANCE)**

SiC heat exchangers are assembled as a stack of single elements which are then inserted into a metallic shell with seals in between



# SOLUTIONS FOR HEAT EXCHANGERS

## + KEY FEATURE

- **Excellent thermal conductivity of SiC** (efficient heat transfer)
- **Universal corrosion resistance** (unique anticorrosive solution)
- High erosion resistance allowing higher velocity
- No particle emission, No contamination for high purity application

## + CUSTOMER BENEFITS

- Compact heat exchangers
- Solutions suitable for extreme environments
- Easy maintenance
- Long-time life, Cost effective
- Gasket failure system detector available
- Design according to International standards (PED, TÜV ...)



# SOLUTIONS FOR ... OTHER APPLICATIONS

HIGH RF  
ABSORPTION



Telecommunication satellites  
Scientific instrumentation

HIGH RESISTANCE TO  
CORROSION, ABRASION,  
WEAR  
HIGH THERMAL  
CONDUCTIVITY



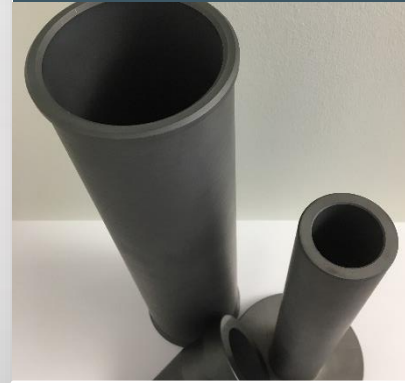
Seal rings  
Sliding bearings  
... up to Ø 1300 mm

HIGH RESISTANCE TO  
CORROSION AND  
HIGH TEMPERATURE



Chemical Industry:  
SPS tooling, tiles, tubes,  
rings, gears, ...

RESISTANCE TO HIGH  
TEMPERATURE AND  
COMPATIBILITY WITH  
NON-FERROUS MOLTEN  
METALS



Non-ferrous metallurgy  
Nozzles, tubes

# More information



[www.mersen.com](http://www.mersen.com)

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