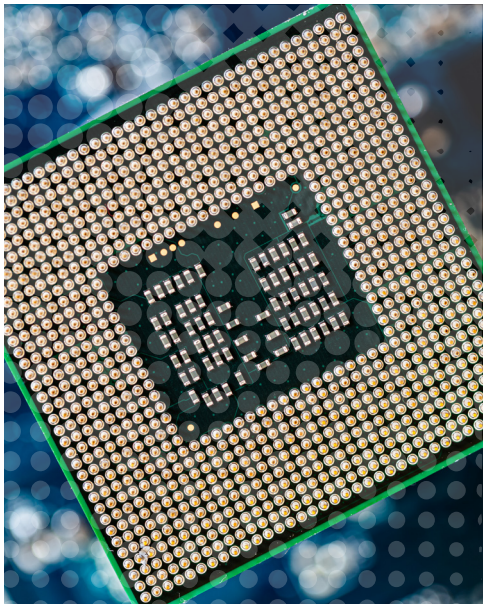
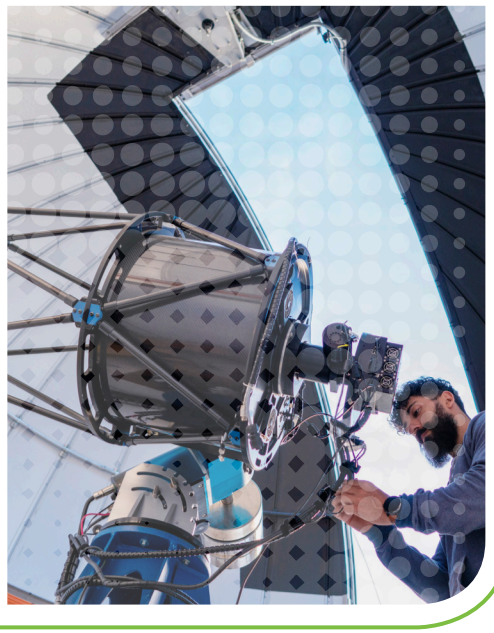
NEWPORT FREEFORM REPLICATED MIRRORS
NON-ROTATIONALLY SYMMETRIC OPTICAL SURFACE





OPTIMIZE SYSTEM PERFORMANCE THROUGH FREEFORM REPLICATED MIRRORS

At MKS, we strive to create opportunities for our customers to meet the continuing challenges of improving system performance to stay a step ahead in capabilities and cost. Replicated freeform mirrors provide designers additional degrees of freedom when developing a new instrument or updating existing systems. Enhanced freeform design options provide improvements in overall instrument performance and potentially cost. Newport's unique manufacturing and replication processes are recognized as an industry leader for custom high-precision replicated mirrors and has expanded this to freeform applications.

Freeform Design Advantage

Optical system designers can save time by using a computer-generated model based on the optical specifications and constraints of a system's concept to determine the ideal freeform optical components that maximize the overall system performance.

The traditional method, without freeform optics, requires a designer to spend time identifying available optical components and analyzing multiple optical systems to find the closest approximation to the ideal system design. Considering a freeform design from the beginning can reduce design time and maximize overall system performance.

Freeform Benefits

- Next generation system design
- Flexibility of design environment and tolerances
- Improved aberration correction
- Fewer optics and alignment requirements
- Higher image quality
- Increased optical throughput
- Reduction of instrument mass and volume

Design to Manufacturing

The experienced team dedicated to fabricating Newport's replicated mirrors can work with 3D models, cloud of points functions, or equations to assist in optimizing freeform replicated mirrors for function and manufacturability. The design concept merit functions are reviewed by our Engineering team to establish the tooling surface geometry and verify our modern CNC tooling capabilities to meet the freeform fabrication requirements.

Design Software and Data Points

Modern fabrication tools incorporate values generated from software to manufacture complex surface shapes. Common methods and software tools used to create freeform surfaces ensure that the correct form is maintained. Ideally this would include a three-dimensional model which allows our engineers to verify the design and orientation of the product.

Mathematical (formula based)

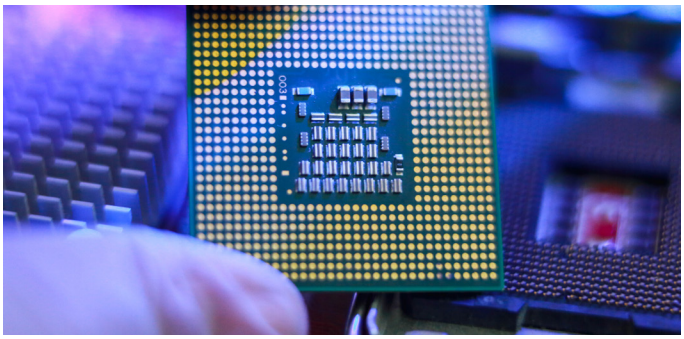
- Acylindric
- Biconic
- Off-axis parabolic
- Polynomial
- Toric
- Others

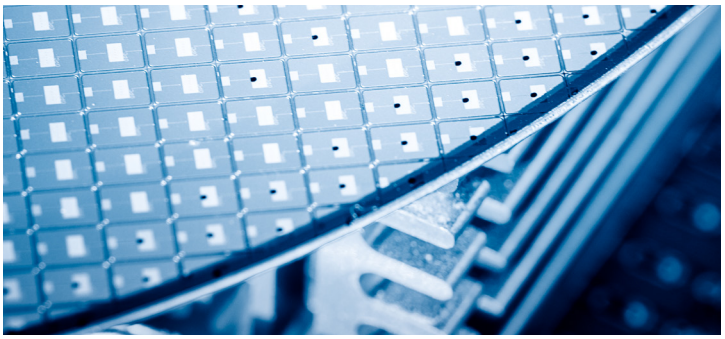
Cloud points or SAG tables

- CODE V
- FRED
- MATLAB
- OpticStudio

Graphic software

- CAD
- Solidworks





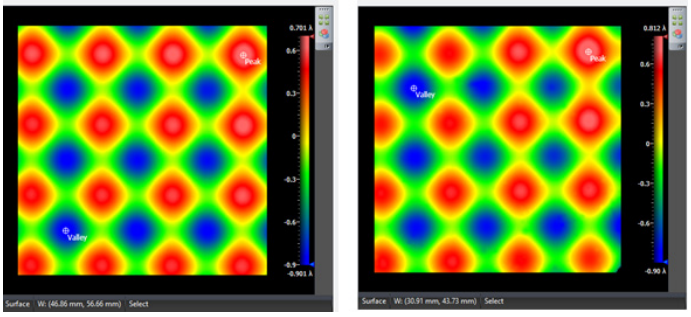
Monolithic Design

Incorporating a metal substrate into the freeform replicated mirror design provides solutions that can combine features to improve mounting, installation, and system stability.

- Provides an accurate mounting surface aligned to the optical surface
- Incorporate mounting features or kinematic adjustment mechanisms to reduce installation and alignment time
- Design flexibility to locate optical surface in otherwise inaccessible locations
- Produce low inertia optics or incorporate light weighting features
- Eliminate alignment issues due to temperature excursions, vibration, and shock
- Match temperature coefficient of expansion to the optical bench and minimize system changes due to ambient temperature change

Freeform Metrology

Measuring freeforms can be limited based on the complexity of the form. Newport utilizes surface profilers and interferometers to define the deviation from best-fit sphere departure and slope change limits to optimize or adjust the mirror's performance and achieve an outcome with the highest precision possible.



Replication from master to product for non-standard shapes can maintain high fidelity. In this example the Peak to Valley change from Master to Final Replica 0.008 mm ≈ 0.8%

Reliable Source

With over 45 years of providing superior replicated optical components Newport continues to provide innovation by adding freeform replicated mirrors to our capabilities. Replication delivers unmatched repeatability for volume manufacturing of mirrors as each mirror is an exact copy of the master from which it is made. Our unique combination of opto-mechanical engineering, manufacturing, and testing expertise ensure that the finished products will consistently meet all expectations.

Freeform Replicated Mirror Specifications and Capabilities

Spectral Range	200 nm to 15 µm
Reflectance	85% to 99% (dependent upon wavelength)
Coating	Bare Aluminum, Bare Gold, and Protected Aluminum
Surface Quality	60/40 per MIL-F-48616 (typical)*
Surface Roughness	25 Å (typical)*
Coating Adhesion	MIL-F-48616
Coating Hardness	Protected Aluminum per MIL-F-48616 (modified to 0.05 lb.)
Operating Temperature Range	-60°C to 100°C
Humidity Resistance	MIL-F-48616
Wavefront Distortion	Fit to freeform shape
Size Range	3 mm to 300 mm (typical)
Substrate Material	Aluminum, Silicon Carbide, and Glass

**Call to discuss additional requirements*

To find out more about our Newport Freeform Replicated Mirrors technology and what MKS can do for you, get in touch with a member of our team today.

Scan QR code for more information or visit **www.newport.com/Freeform** or call **508-528-4411** to speak directly to a Technical Sales Engineer or email **craig.hanson@mksinst.com**

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Newport is a brand within the MKS Instruments Photonic Solutions division. The Newport product portfolio consists of a full range of solutions including precision motion control, optical tables and vibration isolation systems, photonic instruments, optics and opto-mechanical components. Our innovative Newport solutions leverage core expertise in vibration isolation and sub-micron positioning systems and opto-mechanical and photonics subsystems, to enhance our customers' capabilities and productivity in the semiconductor, industrial technologies, life and health sciences, research and defense markets.

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