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Optical, Power and Thermal Management Technologies

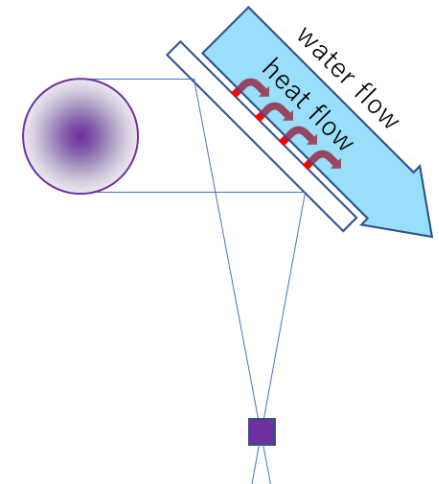
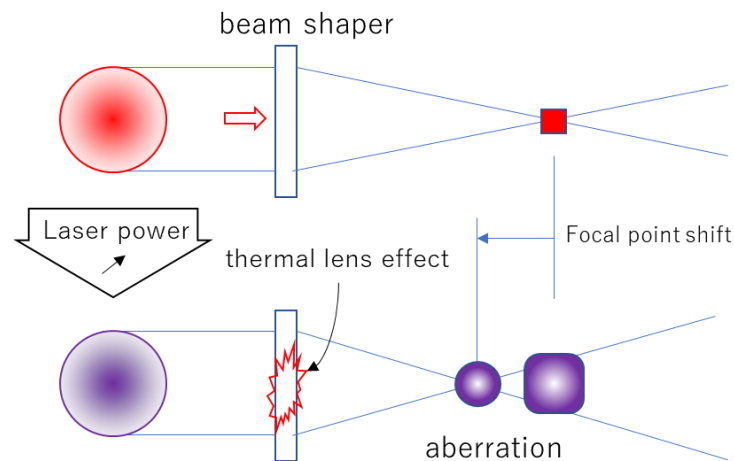
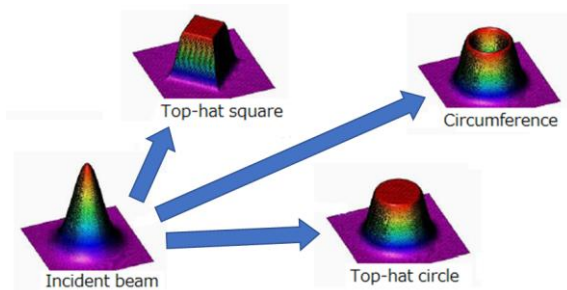
## Deflecting and Beam shaping for Laser welding applications

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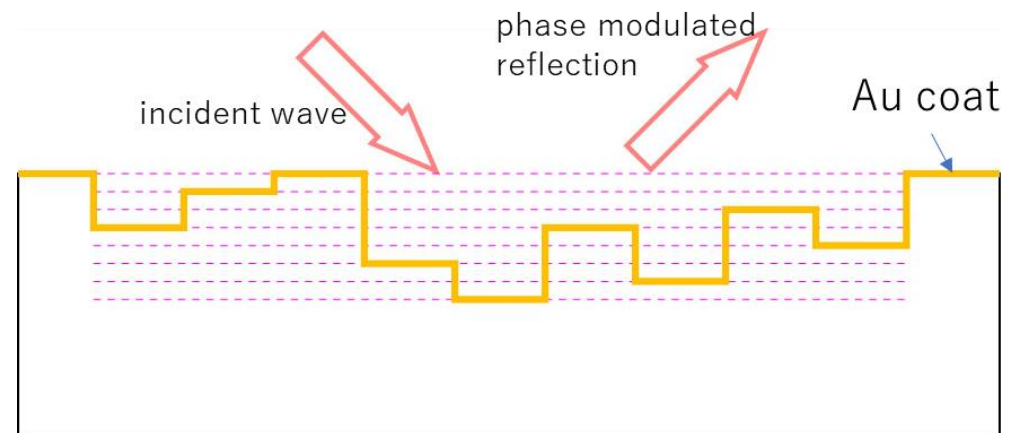
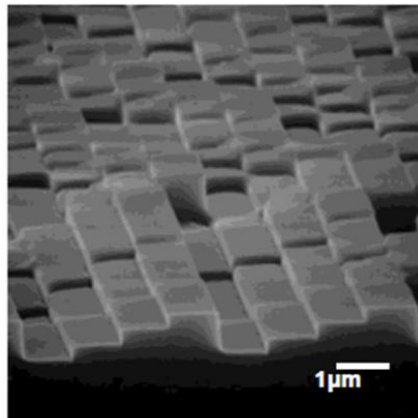
# General Idea – why reflective?

- DOE based beam shaper can transform the incident beam profile to a designated profile with a single plate
- Conventional transparent beam shaper suffers from thermal lens effect with high laser power exceeding 5 kW, which results in focal point shift and aberrations
- The reflective beam shaper can be water-cooled on its back plane to get rid of the thermal lens effect.



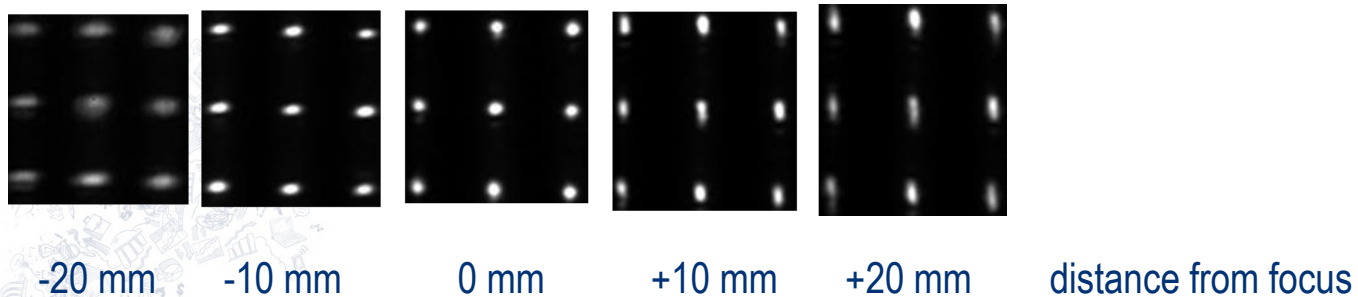
# Structure of the beam shaper

- NTT-AT can handle substrates made of SiC, Si, SiO<sub>2</sub> etc., on which a multiple level depth structure is formed.
- The maximum efficiency depends on the depth levels.
- Its surface is coated by thin film such as Au for higher reflectivity.
- Surface structure is designed upon customer's request, such as wavelength, incident reflection angles, designated focal length, depth and pattern and the M<sup>2</sup> of the incident light.



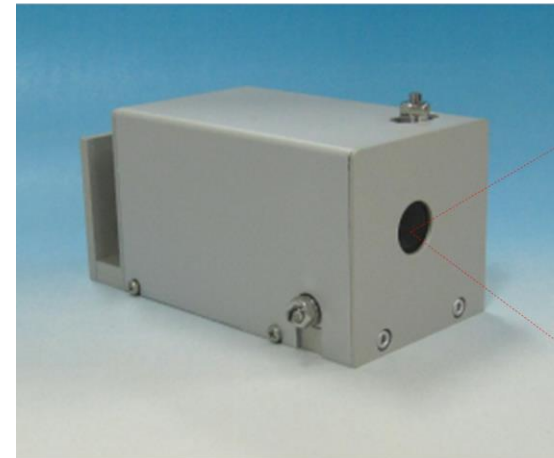
# Example – Beam Shaper for 26x26 spots

- 23mm x 32.5 mm beam shaper for 1.06  $\mu\text{m}$
- Designed to generate a 25 mm x 25 mm square consisting of 26x26 spots with a spacing of 1 mm each at 350 mm away from the beam shaper
- The incident and the reflected beam are slanted by 45 degree to the normal of the beam shaper.
- The bottom pictures show a 3mm x 3 mm area around the focal plane.



# KTN Solid-State Beam Deflector

- KTN,  $K \text{Ta}_{1-x} \text{Nb}_x \text{O}_3$  crystal with very large Kerr effect,
- All solid-state deflector with novel working principle based on refractive index change in a space discharge
- Space discharge is modulated by high voltage
- Operation frequency: 10 kHz ... 100 kHz
- Beam diameter: 0.5 mm (2 mm)
- Damage Threshold:  
for cw lasers:  $300 \text{ kW/cm}^2 @ 1064 \text{ nm}$   
for pulsed lasers:  
 $0.1 \text{ J/cm}^2 @ 1064 \text{ nm}, 1 \text{ ps}$   
 $37 \text{ J/cm}^2 @ 1064 \text{ nm}, 10 \text{ ps}$



# Summary

- What can we do for you:
  - provide all solid-state beam shaper for high power in the kW range for welding applications
  - provide all solid-state high speed beam deflector for mid to high laser for applications
- What can they do for us:
  - looking for partners who are willing to test devices in high power applications
  - looking for industrial partners and customers

