

Diffractive Optical Elements (DOE): Beam Splitter & Shaper

— Modifying lasers through diffraction

Introduction

DOE technologies are emerging in the optics industry. Its applications range from technical optics such as scanning and metrology, to bioimaging and printing. DOE are added to laser systems to control the incident beam's phase and amplitude, to 'shape' the beam to a desired output pattern with distinctive functionality. It uses a surface complex micro-structure to direct photons for the specific function.

Operation Principle

A DOE beam splitter is used to split a collimated incident beam into multiple beams. The power is shared between the resultant beams. These beams, form a 1xN array (1-dimension) or MxN array (2-dimension) depending on the setup. Resultant beams exit the beam splitter with separation angle θ (Figure 1). For odd number of beams (N), there is a desired beam that falls on the 0-order. For even number of beams, there is no beam on the 0-order. To achieve well-defined spots at the desired working distance, focusing lenses are often used, as seen in Figure 1 and 2.

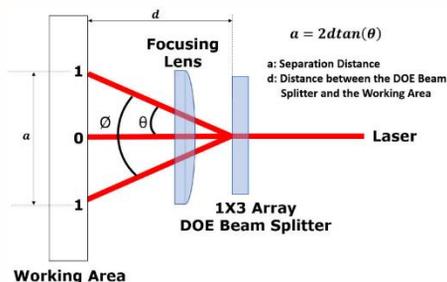


Figure 1. 1x3 Array Beam Splitter

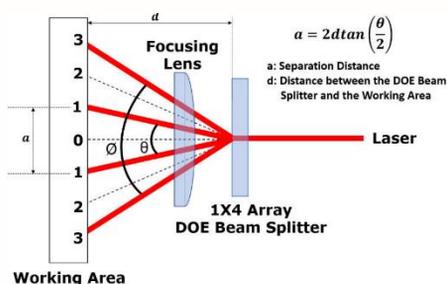


Figure 2. 1x4 Array Beam Splitter

| Series Module | DOE-355-1x3 | DOE-355-1x4 |
|------------------|-------------|-------------|
| Wavelength* | 355nm | |
| Beam Mode | SM or MM | |
| Number of Spots* | 1x3 | 1x4 |

Table 1. Specifications of Beam Splitter

*DOE can be customised to a preferred wavelength, spot size, focal length, and divergent angle of beam.

A DOE beam shaper setup typically consist of a laser, a DOE beam shaper, a scan system/lens, and the working surface (Figure 3). The beam shaper DOE distributes the energy of a Gaussian beam spot to a Top-Hat profile with uniform intensity. This ensures an even laser irradiation on the working surface. The top-hat profile, is identified by a sharp transition area that generates a clear boundary between treated and untreated regions. The output profile can either be rectangular or circular, (Figure 4).

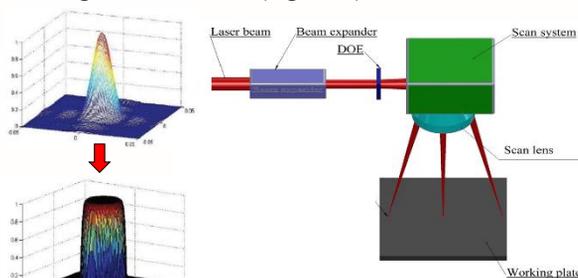


Figure 4. Beam Shaper setup

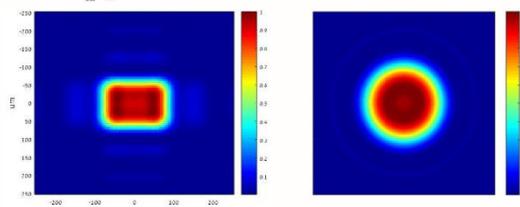


Figure 4. Output profile (rectangular/circular) after beam shaping

| Series Module | DOE-9.4-150x200 | DOE-SCAN-1064-163 |
|---------------|--|-------------------|
| Beam Mode | SM TEM ₀₀ with M ² < 1.5 | |
| Element Type | Window | |
| Shape | Rectangular | Circular |

Table 2. Specifications of Beam Shaper

Applications

Being able to modify and isolate the resultant beam has proved useful in uses such as scanning the surface of skin or implementing perforation on cigarette filters. The systems could be used in, but not limited to the following application scenarios:

- Laser Display
- Laser Welding
- Laser Scribing
- Fibre Optics
- Laser Applications for Medical Purposes

Conclusion

As a global enterprise, leading photonics innovation since 2002, WOE has built up customization engineering capability for thermal imaging, inspection and measurement systems.

