

Beam Splitting

Beam Splitting elements are diffractive optical elements (DOE) used to split a single laser beam into several beams, each with the characteristics of the original beam.

FEATURES

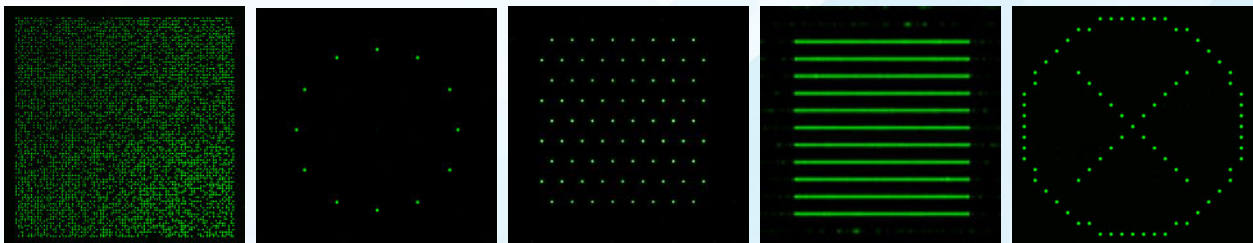
- Accurate angle separation
- Insensitive to X-Y-Z displacements
- Custom separation angle and shape
- Any input beam shape
- High power threshold
- Wavelengths from UV to IR
- Optional AR/AR coating

APPLICATIONS

- Parallel material processing
- Medical/aesthetic treatment
- Laser scribing (solar cells)
- Glass dicing (LCD displays)
- Laser display & illumination
- Machine vision & 3D sensors
- Fiber optics

DOEs can generate unique optical functions that are not possible by conventional reflective or refractive optical elements, providing greater flexibility in system configuration. Among the few advantages are: small footprint, fast/high throughput thanks to simultaneous processing, tailored energy distribution, etc. The operational principle is quite straightforward; from a collimated input beam, the output beams exit the DOE with a predesigned separation angle and intensity. Several examples are presented in Fig.1.

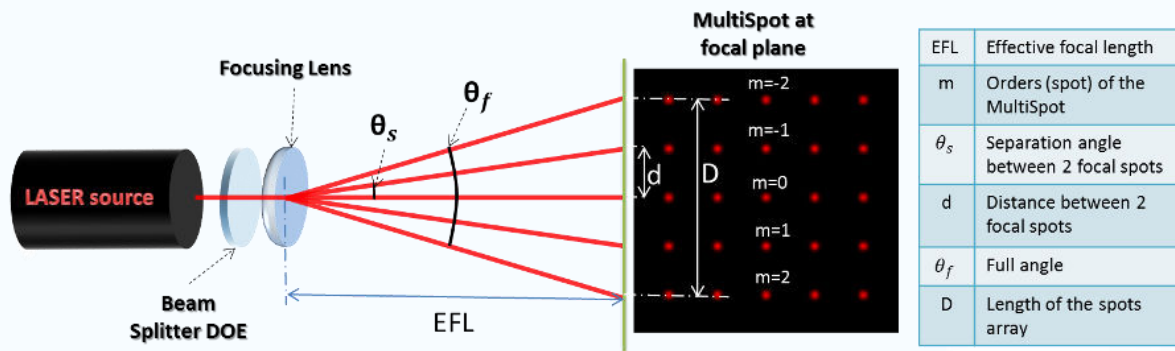
Figure 1 Examples of Multi-spot DOEs



DESIGN CONSIDERATIONS

1. In order to achieve well-focused spots at a certain distance, one needs to add a focusing lens after the DOE, as shown in figure 2 below.

Figure 2 Schematic set-up



2. In order to obtain the right lens, use the following mathematical relationship between the effective focal length (EFL), separation angle (θ_s), and inter-spot distance/ pitch (d):

$$d = EFL \times \tan(\theta_s)$$
3. In double-spot configuration, **power efficiency** can reach ~80%, and for multi-spot (>2) 85% is achievable, for a **binary (2 level)** etching process. In **multi-level** etching, efficiency can reach up to 95%. The remaining power is distributed among the other (parasitic) orders.
4. Energy distribution can be designed for either **spot uniformity** or for any non-uniform distribution meeting the application's requirements.
5. The **minimum input beam size** should generally be at least 3 times the size of the **period** in the DOE. The **period** is given by the grating equation:

$$\Lambda = \frac{m\lambda}{\sin\theta}$$
 Where, Λ =period of DOE, m =diffraction order, λ = wavelength, θ = Separation angle between beams

SPECIFICATION RANGE

Materials	Fused Silica, ZnSe, Plastics
Wavelength range	193 nm to 10.6 um
Separation angle	0.001° to 60° (larger angles require additional optics)
DOE design	Binary, 8-level, 16-level, and more
Diffraction efficiency	64%-98%
Element size	2mm to 100mm
Coating (optional):	AR/AR
Custom Design:	Almost any symmetry or arbitrary shape

