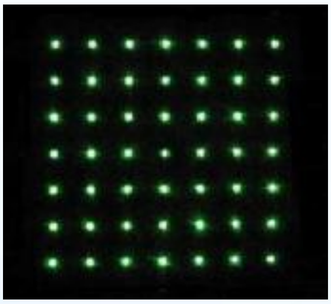
Beam Splitting



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.

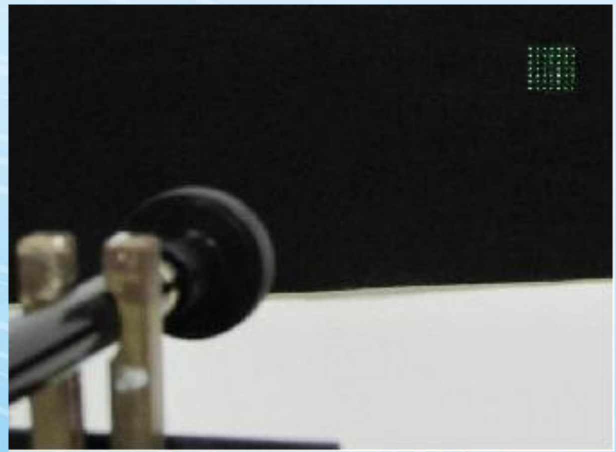
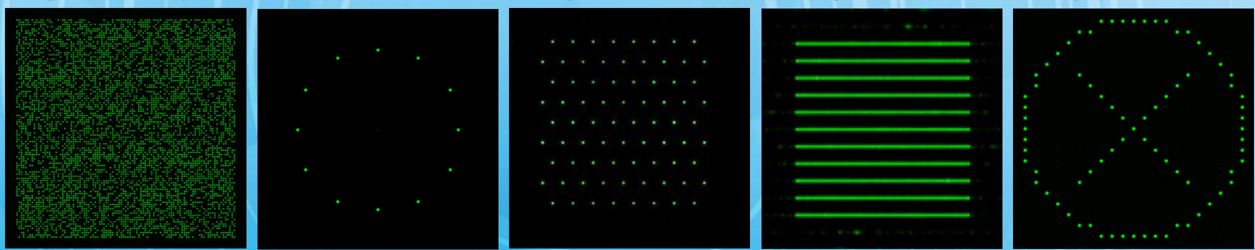
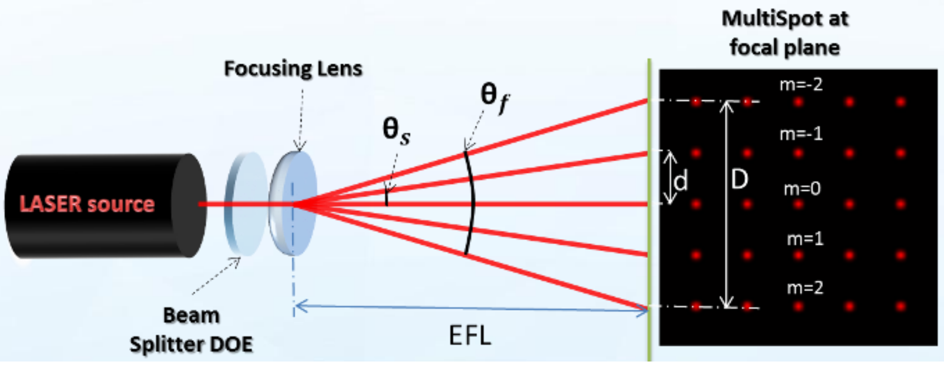


Figure 1 - Examples of Multi-spot DOEs. From left to right: Random, Round, Hexagonal, Viewfinder, Multiple lines



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.



EFL	Effective focal length
m	Orders (spot) of the MultiSpot
θ_s	Separation angle between 2 focal spots
d	Distance between 2 focal spots
θ_f	Full angle
D	Length of the spots array

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**):

$$d = \mathrm{EFL} \times \tan(\theta_s)$$

3. In double-spot configuration, **power efficiency** can reach ~80%, and for multi-spot (>2) 85% is achivable, 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.

Specifications:

Materials:	Fused Silica, ZnSe, Plastics
Wavelength range:	193nm to 10.6um
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 V-Coating
Custom Design:	Almost any symmetry or arbitrary shape