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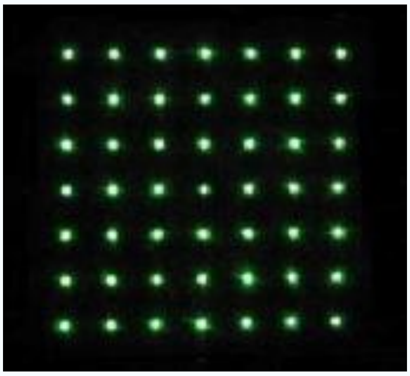


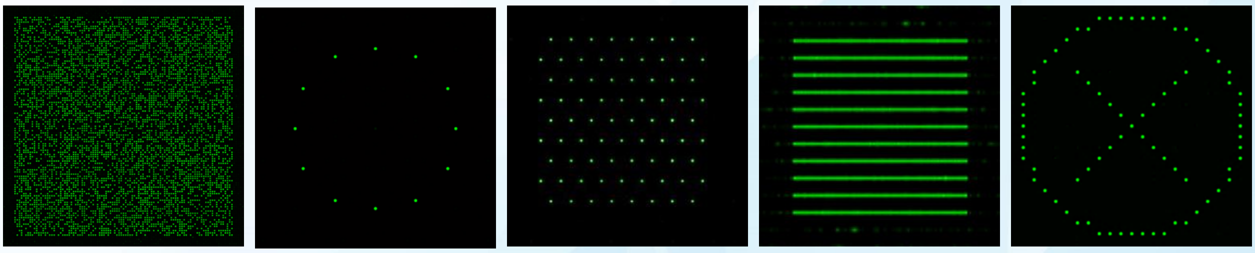
Beam Splitting

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	APPLICATIONS
Accurate angle separation	Parallel material processing
Insensitive to X-Y-Z displacements	Medical/aesthetic treatment
Custom separation angle and shape	Laser scribing (solar cells)
Any input beam shape	Glass dicing (LCD displays)
High power threshold	Laser display & illumination
Wavelengths from UV to IR	Machine vision & 3D sensors
Optional AR/AR coating	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



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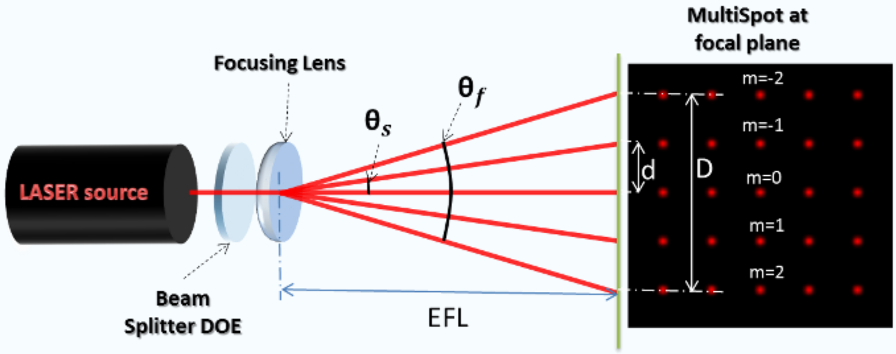
DESIGN CONSIDERATIONS

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



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

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**):

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

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

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

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