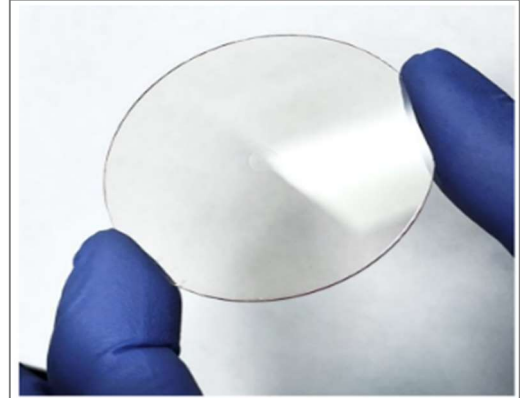



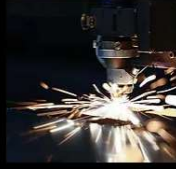

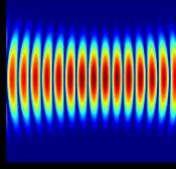
## STOB Series Flat Lenses

Our flat lenses are perfect for laser processing tools. They provide extended depth-of-field, making it easy to mark a variety of objects with precision. Whether you need to mark a metal part with a serial number or weld a plastic part together, this lens will make the job easy. It is a new generation of ultralight, low cost, high performance metalens surfaces.

Our lenses are perfect for applications where high resolution over an extended depth of field is required. Each lens has a very low profile, making it easy to integrate into your system. It is also customizable for any laser wavelength and beam diameter, making it perfect for your needs. Our lenses are carefully crafted via lithography to provide the best results each time. With our lenses, you can experience enhanced precision, quality, and reliability in a variety of laser processing tools.



We have created an advanced optical surface design technology that enables ultralight, low cost and high performance metalens surfaces. Our domain expertise in optical design and high precision volume manufacturing allows us to deliver optical performance and capability previously unachievable with traditional refractive, diffractive or metalens methods.

			
<b>TIME OF FLIGHT</b>	<b>LASER MARKING</b>	<b>THERMAL IMAGING</b>	<b>BEAM SHAPING</b>
High resolution LIDAR and time-of-flight optical solutions	Precise laser marking and high power laser machining capabilities	Broadband NIR to LWIR infrared optical imaging solutions	Customized optical elements for beam shaping, diffractive optical (DOE), and diffuser applications

### 1. STOB Series Flat Lenses for Extended Depth of Field

Flat lenses are perfect for laser processing tools, they provide extended depth-of-field, making it easy to mark a variety of objects with precision. Whether you need to mark a metal part with a serial number or weld a plastic part together, this lens will make the job easy. This lens boasts the following advantages:

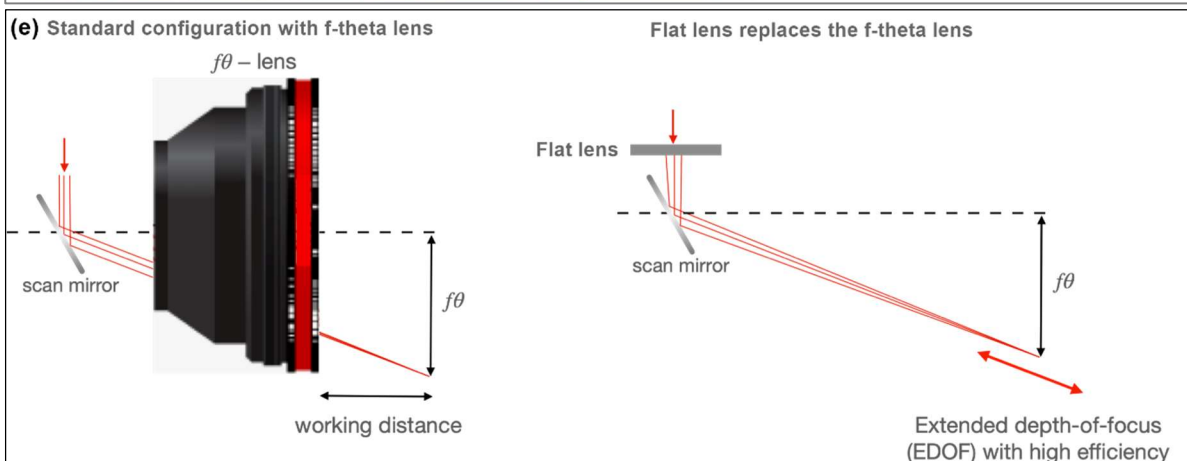
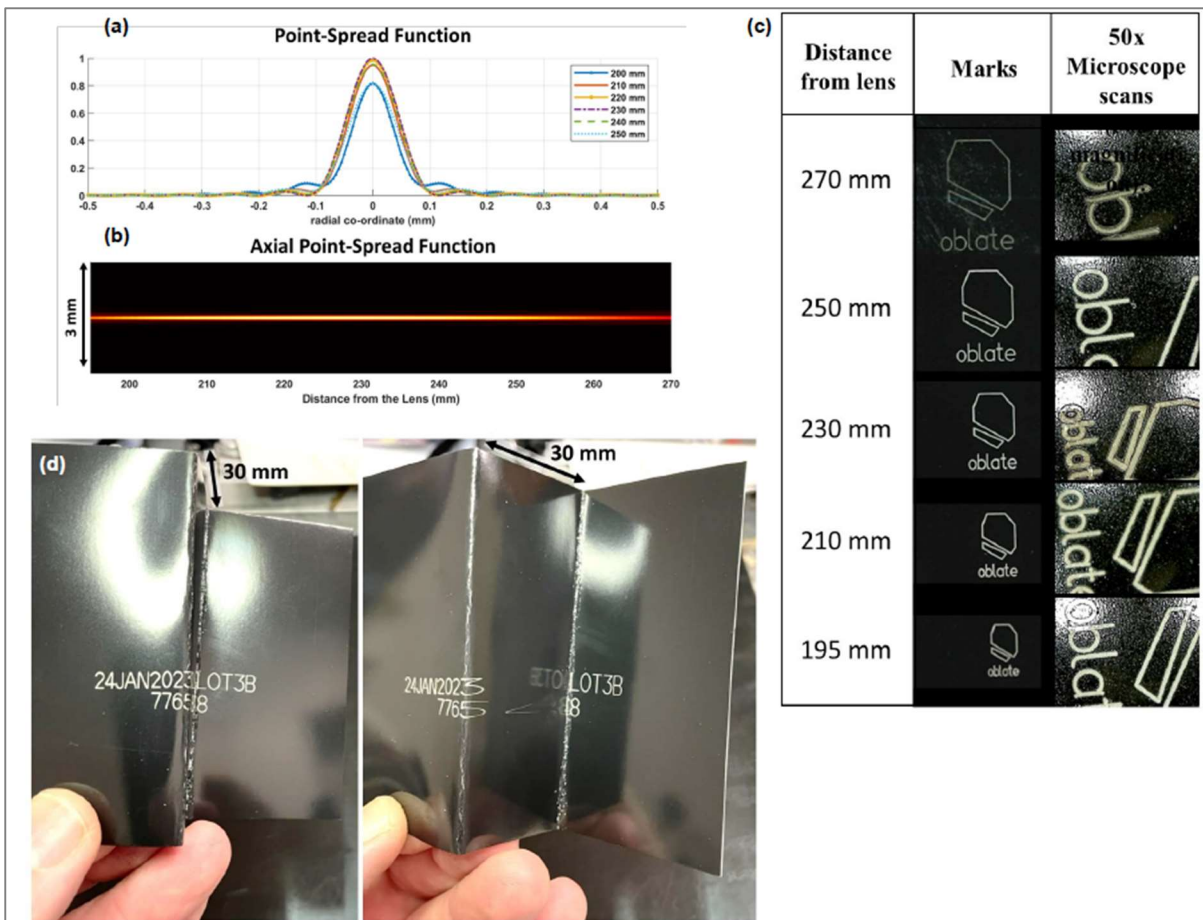
- Extended depth of field (>75 mm)
- Excellent PSF performance
- Ultralow profile
- Low-cost, large volume manufacturing
- Customizable for any laser wavelength
- Tolerant to high laser fluences

**Specifications:**

Optical Specifications	
Wavelength	1064nm
EFL	195-270mm
DOF (extended)	75mm
Lens Diameter	3mm
Transmission Efficiency	>90%
Tolerant to High Laser Power	
Mechanical Specifications	
Diameter	3mm

Thickness	<1mm
Weight	<1gram
<b>PSF Spot Size (FWHM)</b>	
195mm from lens	78 $\mu$ m
225mm from lens	103 $\mu$ m
270mm from lens	98 $\mu$ m

The performance of the extended depth of field (EDOF) flat lens is shown below. The calculated Point-Spread Function (PSF) shows good focusing for the extended depth of focus range in Fig. (a). The calculated PSF as a function of distance from the lens is also shown in Fig. (b). To the right Fig. (c), standard black-card mark tests are shown from 195 - 270 mm from the lens as well as microscope scans of the marks (50x magnification). No refocusing was performed as the target distance was changed. While the size of the mark varies due to galvo drawing, the spot size remains uniform. In the lowermost photographs Fig. (d), a standard black-card mark test was made on a folded card where the two surfaces of the card were spaced 30 mm apart. The markings are clear and distinct on both surfaces. Besides, the flat lens can replace the f-theta lens which is more space-saving and cost-effective, as shown in Fig. (e).



**Ordering number:**

STOB-EDF-WW-XX-YY

WW : wavelength

XX : effective focal length (EFL)

YY : Depth of field

Example: STOB-EDF-1064-195-55

Wavelength = 1064nm

EFL =>195mm

Depth of field = 55mm

The table showing some of our capability is below

Wavelength	EFL	DOF	Diameter	Spot Size
355 nm	25 - 100 mm	25, 50 mm	3 - 6 mm	25 - 250 um
532 nm	25 - 100 mm	25, 50 mm	3 - 6 mm	25 - 250 um
1064 nm	25 - 100 mm	25, 50 mm	3 - 6 mm	25 - 250 um
10.6 um	25 - 100 mm	25, 50 mm	3 - 6 mm	50 - 250 um

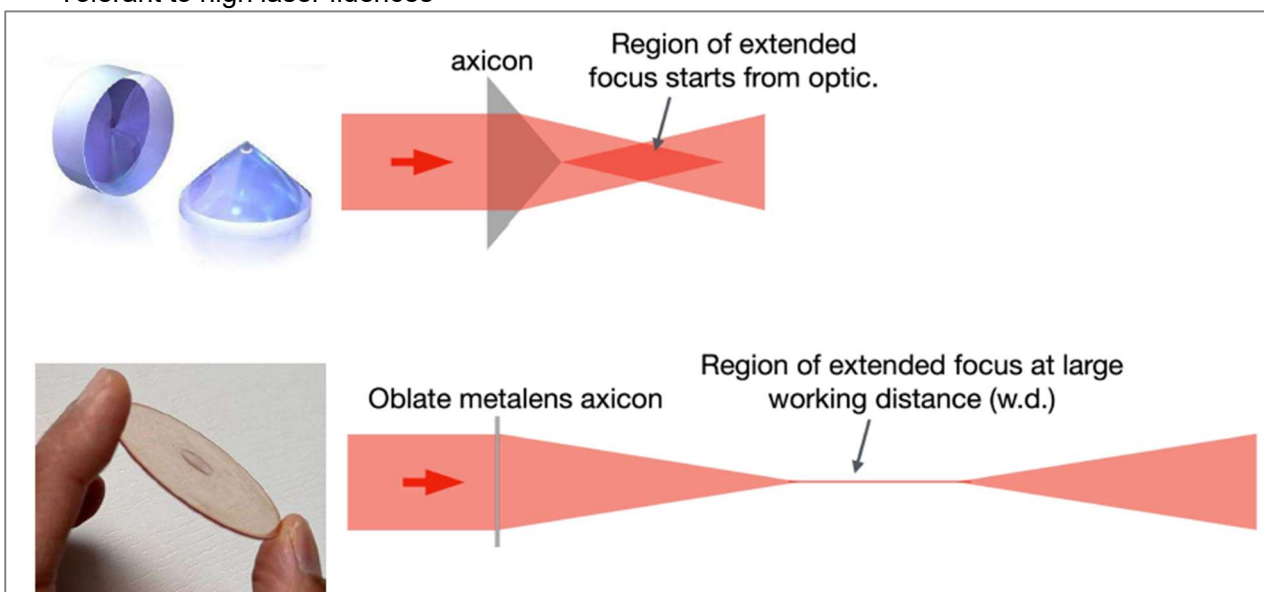
For ordering a metalens, please tell us your requirements on laser wavelength, effective focal length, depth of focus, beam diameter, required focal beam diameter and quantity.

**2. STOB Series Metalens Axicon Lenses for Extended Depth-of-field Application**

We are the exclusive manufacturer of metalens axicon lenses suitable for applications where high resolution over an extended depth-of-field is desired. Applications include laser marking, machining, welding, microscopy, imaging & ophthalmology.

Such lenses afford the following advantages:

- Extended depth-of-focus (for example >70mm @ w.d. of 125mm).
- No need for slow & expensive refocusing mechanisms.
- Larger working distances than conventional axicons (>250mm possible)
- Uniform peak intensity over the extended depth-of-focus (DOF)
- High efficiency & diffraction-limited spot sizes.
- Low cost, thin (<1mm) & lightweight (1g)
- Customizable for any laser wavelength & beam diameter
- Tolerant to high laser fluences



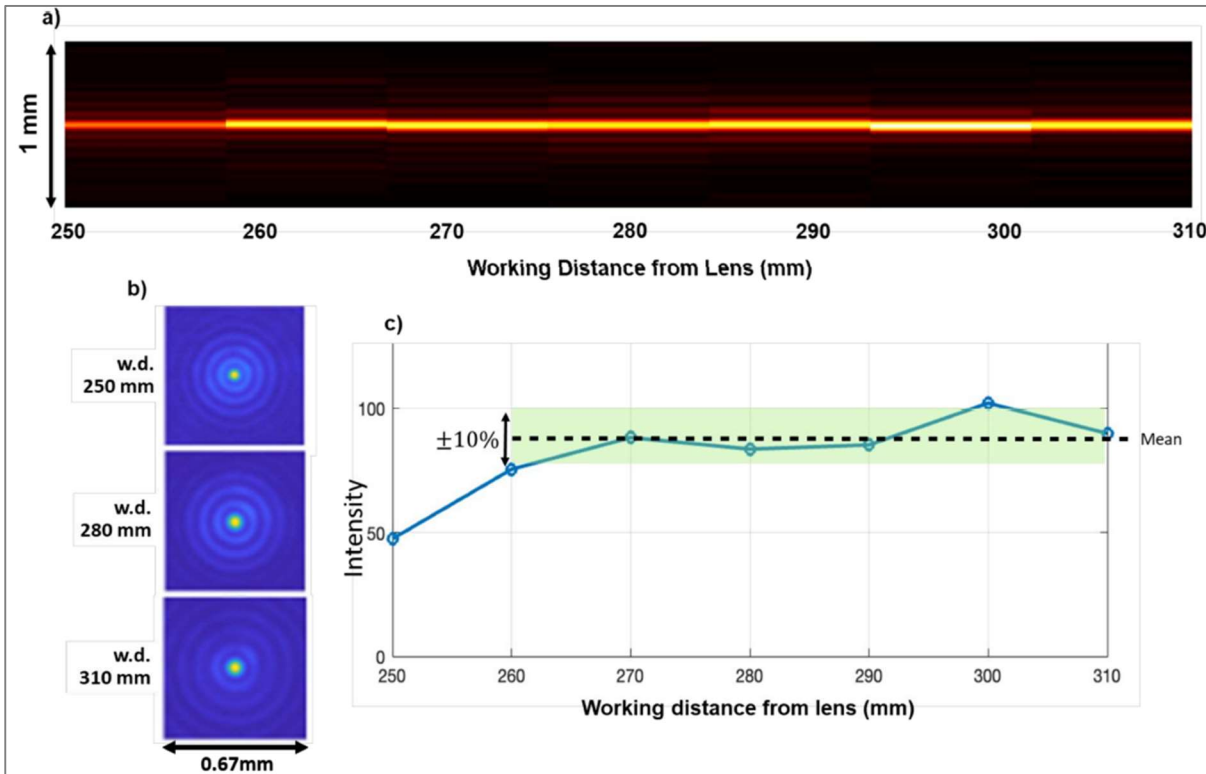
The following lens specification are representative of our axicon metalens technology capability. Please contact us for other specifications.

Part Number	STOB-1064-6-280
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Wavelength	1064nm
Diameter	6mm
EFL	280mm
DOF (extended)	50mm
Spot Size (FWHM)	<67 $\mu\text{m}$
On-Axis Intensity Variation	+/- 10%

### Experimental Data

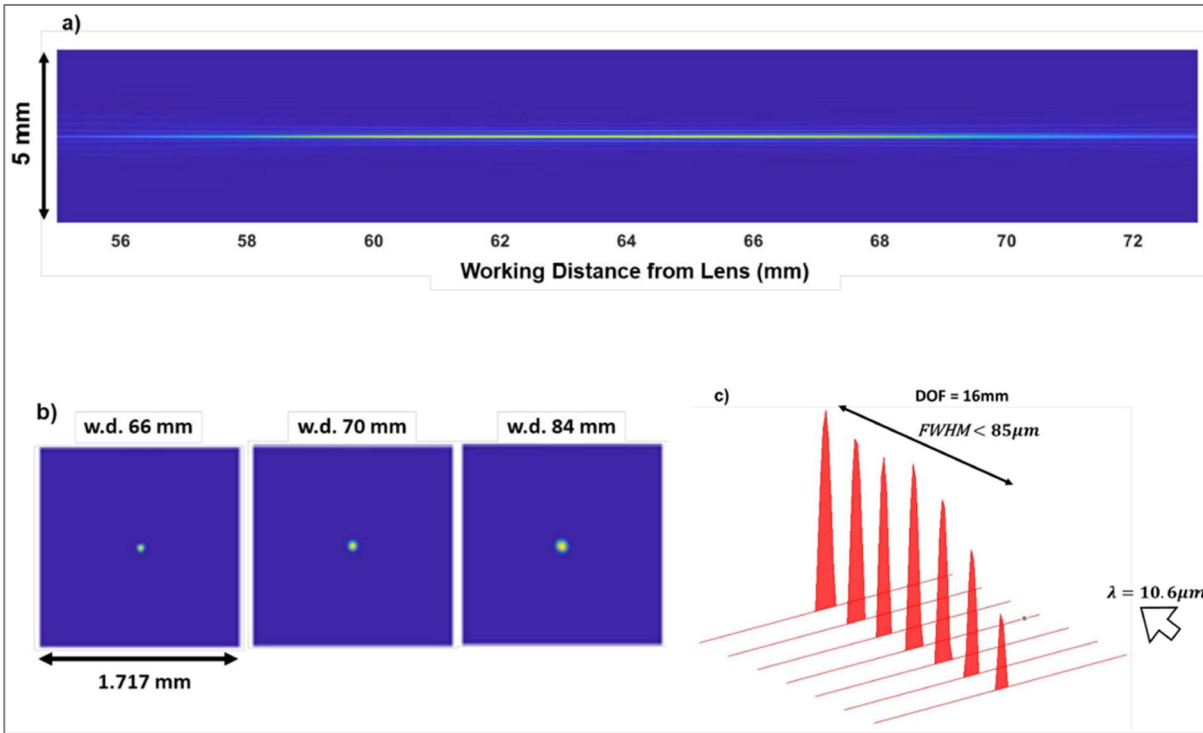
- axial Point-Spread Function
- Point-Spread Function at three distances from the lens,
- Peak intensity of on-axis spot. Variation along the working distance is +/-10%



Part Number	STOB-10.6-8-64
Wavelength	10.6 $\mu\text{m}$
Diameter	8mm
EFL	64mm
DOF (extended)	16mm
Spot Size (FWHM)	<85 $\mu\text{m}$

### Experimental Data and Compute Simulations

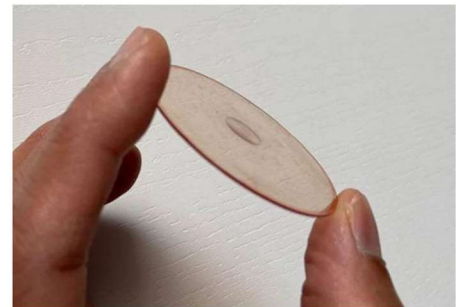
- Computer simulation of axial point-spread function
- Experimental data of point-spread function at three distances from the lens
- Experimental data showing measured depth of field and FWHM of spot size.



### 3. STOB Series FOV Infrared Lenses for Time-of-Flight Applications

We have designed and built an ultra-low profile diffractive metalens suitable for applications where an extended field of view is required. This technology boasts the following advantages:

- Field of view of 80 degrees
- Excellent PSF performance
- Ultralow TTL (< 2.5 mm)
- Low-cost, large volume manufacturing
- Customizable for any wavelength

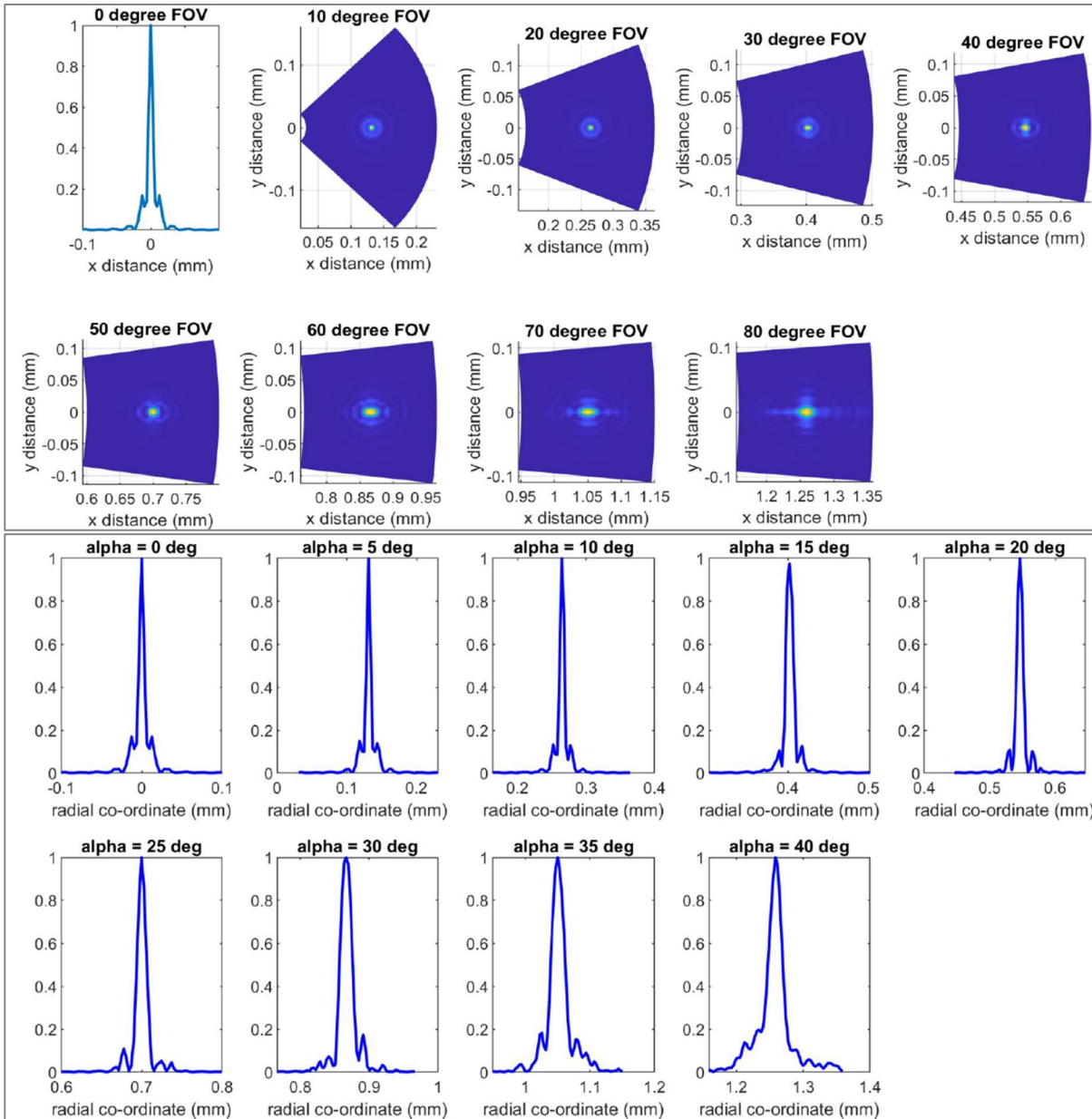


The following lens specifications are representative of our infrared metalens technology capability. Please contact us for custom requirements and design capabilities.

#### Specifications of the STOB Series Infrared TOF metalens with Large Field of View

Optical Specifications	
Wavelength	850nm
EFL	1.5mm
FOV	80 degrees
Spot size (FWHM)	Diffraction limited
Lens Diameter	0.42mm
Transmission Efficiency	>90%
Mechanical Specifications	
Diameter	0.42mm
Thickness	<1mm
Weight	<1gram
Spot Size (FWHM)	
0 degrees	7.3μm
40 degrees	10.7μm
80 degrees	22.4μm

The performance of the large field-of-view TOF metalens is shown below as Point-spread Function (PSF) at 850 nm. The PSF shows high performance focusing for the entire field of view 80 degrees.



**Ordering number:**

STOB-LFV-WW-XX-YY

WW : wavelength

XX : effective focal length (EFL)

YY : field of view (FOV)

Example:

STOB-LFV-1064-2-70

Wavelength = 1064nm

EFL = 2mm

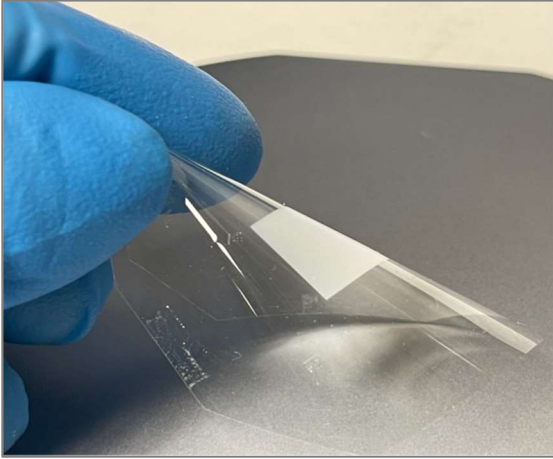
FOV = 70 degree

**4. STOB Series Metalens-Enabled Microlens Arrays for Imaging Applications**

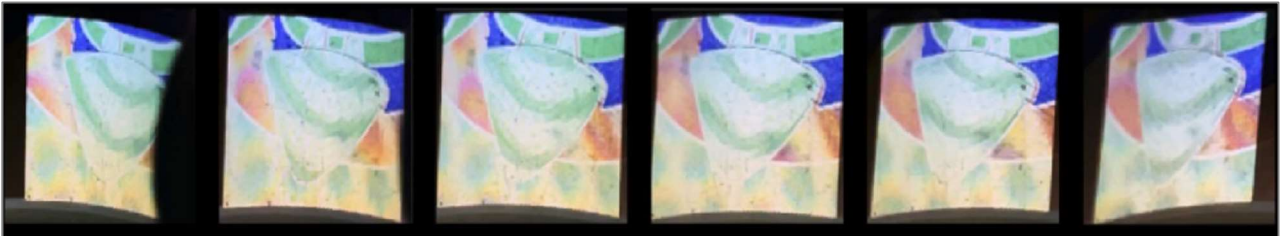
We have designed and built a freeform diffractive microlens array suitable for multiple applications in 3D integral imaging including:

- Anti-counterfeiting technology
- Physical security
- 3D displays
- Lightfield cameras
- Wavefront sensors

- Fiber coupling



Metalens-enabled microlens array on a flexible substrate for imaging applications.  
(Microlens pitch = 70 $\mu$ m, F-number: f/0.5, Substrate thickness 40 $\mu$ m)



Integral imaging demonstrated using a metalens-enabled microlens array and a high-resolution color print. As the print plus the microlens array is tilted three dimensional patterns and colors change. This demonstration has applications in document security.

Major advantages of STOB Series Metalens technology:

- Low f# (0.5 and larger)
- Extended depth of focus for high robustness
- Broadband performance in the visible, NIR, or LWIR
- 100% fill factor
- Flexible device with ultra-low profile
- Low-cost, large volume manufacturing with nano imprint lithography
- Simplified alignment