WAVELENGTH OPTO-ELECTRONIC

Ultraviolet Optics/Detectors
– *For solar-bind imaging and detections*

Introduction

When a high-voltage equipment discharges electricity, corona discharge, arc flash, or arc discharge may occur depending on the electric field strength, during which electrons in the air continuously gain & release energy, emitting UV rays. UV imaging utilizes this principle to receive the UV signals. UV optics are involved in solar-bind imaging. Solar radiation in the wavelength band of 190-285nm is completely absorbed by the ozone layer when passed through the atmosphere. The scattering of other components & the surface ozone in the atmosphere below the ozone layer also absorbs it, creating a natural "solar-blind" near the ground - where the naturally occurring solar signal is almost completely undetectable.

Operation Principle

UV Lens

In UV imaging, UV light signals released are processed & overlapped with the image formed by visible light on a screen, allowing for the position & intensity of the electrical discharge to be determined. Our UV lens is developed for use across x-rays & visible light within the electromagnetic spectrum. Our UV lens has a wavelength over a range from 200nm to 385nm. Its apochromatic lens allows images to be formed across UV to visible light spectrums. It can be used in UV cameras or image intensifier tubes for observation. The addition of a close-up lens allows for obscure fingerprints on surfaces of materials, such as glass, to be detected & efficiently removed.

Figure 1. Photos of typical UV lens assembly

Model	Range
Fixed focus lens	EFL: 10~300mm
Zoom lens(1.5X)	EFL: 40~60mm
Super achromatic lens	Wavelength: 200~1100nm

UV lenses encompass features of chase light caliber, & high accuracy & resolution. In solar-bind imaging, the existence of light in the solar blind ultraviolet band on the earth usually consist of only three cases: (1) an unnatural danger signal, such as gun fire, explosive explosion, fire & corona generated by high-voltage transmission line leakage; (2) a man-made solar-bright ultraviolet light source; (3) an abnormal weather such as strong lightning. This entails that if a solar blind UV signal is detected in the “dark room”, a specific event, such as a missile attack, occurs.

The area within 15 km of the surface layer is free from noise interference, allowing for the target to be detected without sophisticated image processing.

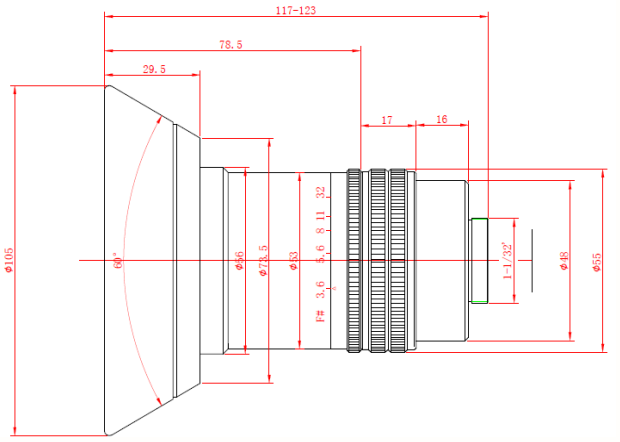

Figure 2. Layout of UV 90-degree wide angle lens

The key specifications of the UV wide angle lens are listed below. Compared to similar products in the market, we offer small wide-angle distortion and better pixel resolution, useful for solar-blind imaging and detection.

Wavelength	254+/-20nm
Focal length	9.2mm
BFL	13.5mm
Aperture	F#3.6 (manually tunable)
FOV (imaging plane)	18mm
FOV (angle)	90°
Working distance	20cm ~ ∞
Angle distortion	</=2%
MTF	70lp/mm>0.3
Mount	C-mount
Working temperature	-40 ~ 50 ° C

Table 1. Key specifications of one type of UV lens

UV Detectors

UV detectors include UV image intensifier tube, UV ICCD/ICMOS and solar-blind UV filter component. These are critical assembly to form the hard core of an UV imaging/detection system. Combining the capabilities of UV detectors and UV lens/optics, we are able to offer customization solutions for different applications.

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Figure 2. UV detectors assembly components

Wavelength	185 - 330nm
Peak response	245nm
Diameter of cathode	18-25mm
Irradiation sensitivity	40 mA/W@254nm
Resolution	20lp/mm
Background irradiation	$5x10^{-11}W/m^2$
Irradiation gain	$10^8(cd/m^2)/(W/m^2)$
Size (mmxmm)	Φ35.5 x17.6/Φ45.5 x18
Working temperature	-55 to 70 ° C

Table 2. Key specifications of UV intensifier tube

Parameters	18-ICCD	25-ICCD
Wavelength	185 – 330 nm	
CCD size	Half inch	
CCD pixels	752 x 582	
Magnification	1:2.2	1:3.1
Resolution	15	
Sensitive area	14mmx10.5mm	20mmx15mm
Output signal	Composite Video /ethernet100fps	Composite Video
Input voltage	DC 12, 5	
Working temperature	-25 to 45 ° C	

Table 3. Key specifications of UV ICCD/ICMOS sensors

Wavelength	264 +/-3nm		
Peak transmission	>20%		
Bandwidth	20+/-3nm		
Serial	RMF-A	RMF-B	RMF-C
Size	Φ31.5 x21.5	Φ31.5 x26.3	Φ37 x21.5
Aperture	Φ22.5		Φ30
Mass	<40g	<50g	<60g
Working temperature	-40 to 60 ° C	-40 to 70 ° C	-40 to 60 ° C
Reliability	GJB-369A-98 and GJB-150		

Table 4. Key specifications of solar-blind UV filters

Applications

UV imaging technology could be used in but not limited to the following application scenarios:

- ship fog breaking piloting
- forest fire alarm
- power grid safety monitoring
- maritime search and rescue
- satellite navigation
- aircraft fog breaking blind drop
- missile approach warning
- document security feature identification under sunlight conditions (passport, license, etc.)
- close-range criminal investigation; search for potential fingerprints, footprints, hidden blood prints, fibers, etc

In power & high-speed rail systems, UV imaging could be used to achieve high sensitivity corona and arc detection as shown in Fig. 3 left; 100% filtered out of sunlight during full day blindness, to achieve high sensitivity corona and arc detection.

Figure 3. Applications of solar-bind UV imaging

Another critical application is forest fire alarming. Compared to existing fire alarm technology which cannot penetrate the “dark room” atmosphere under sunlight, UV imaging provides solar blindness adaptability. Secondly, it is not affected by environmental/weather changes and high-temperature interference sources. Utilizing high-sensitivity UV imaging technology, occurrence of a fire in real time can be detected several kilometres away. It can be covered by setting up a gimbal (as shown in Fig. 3 right) or installing it on a helicopter to cover the entire forest area.

Conclusion

As a global enterprise, leading photonics innovation since 2002, WOE has built up customization engineering capability for precision UV optics manufacturing, UV detector integration, solar-blind imaging, inspection and measurement systems development. For more detailed UV optics, including fixed focus, continuous tunable focus, broadband UV optics, and deep-UV optics etc, please refer to WOE catalogue or website.