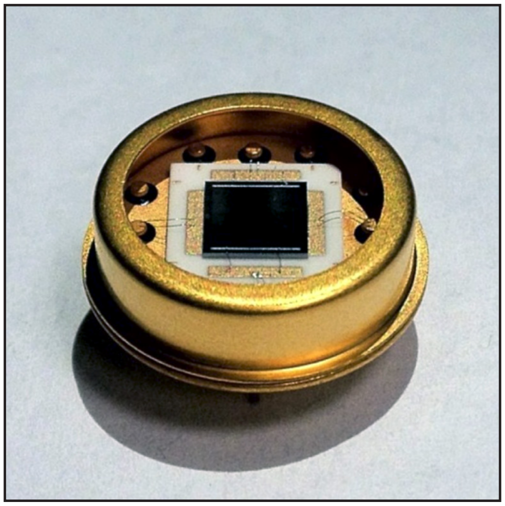

FEATURES

- Submicron position resolution
- Stable response after exposure to UV/EUV
- 5 mm x 5 mm active area
- TO-8 windowless package

RoHS

ELECTRO-OPTICAL CHARACTERISTICS AT 25°C

PARAMETERS	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Active Area			25		mm^2
Responsivity, $\mathcal{R}$	@ 13 nm		0.2		A/W
Responsivity, $\mathcal{R}$	@ 254 nm		0.02		A/W
Dark Current Idr	V_R = 30 V		10	50	nA
Reverse Breakdown Voltage, V_R	I_R = 1 μA	50			Volts
Capacitance, C	V_R = 30 V		40	60	pF
Rise Time	V_R = 30 V, R_L = 50Ω		200		nsec
Shunt Resistance	V_r = ± 10 mV	5			MOhms
Inter Electrode Resistance		5,000	10,000	15,000	Ohms
Temp Coefficient of ID			1.15		Times/°C
Position Non-Linearity[1]			1	2	±%

[1]Valid within 80% of length

THERMAL PARAMETERS

STORAGE AND OPERATING TEMPERATURE RANGE	
Ambient	–10°C to 40°C
Nitrogen or Vacuum	–20°C to 80°C
Maximum Junction Temperature	70°C
Lead Soldering Temperature[1]	260°C

[1]0.08" from case for 10 seconds

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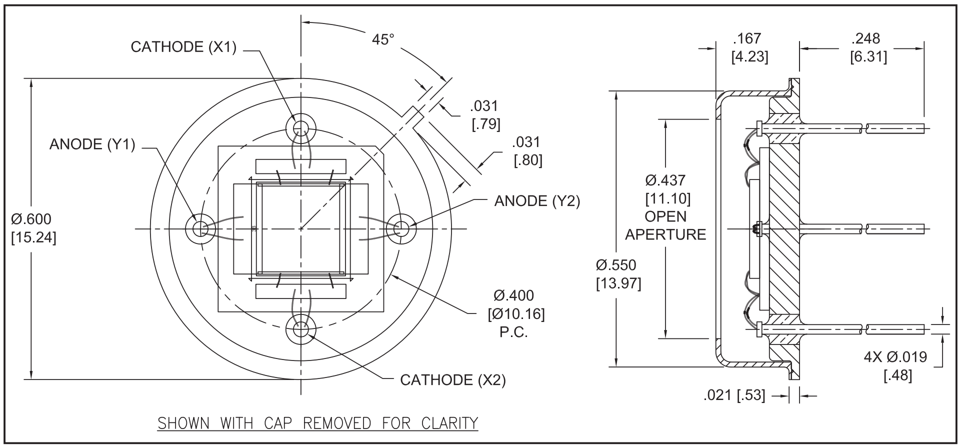
Revision July 30, 2014


CATHODE (X1)
45°
.031
[.79]
.031
[.80]
ANODE (Y1)
ANODE (Y2)
Ø.600
[15.24]
Ø.400
[Ø10.16]
P.C.
CATHODE (X2)
SHOWN WITH CAP REMOVED FOR CLARITY
.167
[4.23]
.248
[6.31]
Ø.437
[11.10]
OPEN
APERTURE
Ø.550
[13.97]
4X Ø.019
[.48]
.021 [.53]

The duo-lateral position sensing photodiode has been developed by Opto-Diode Corporation for position detection of light with wavelength 1 nm to 400 nm. A sectional view of this device structure is shown in Fig. 1. The top n and rear p are the resistive layers which determine the beam x and y positions respectively based on the resistive charge division principle. When a light beam hits the active area (top n-layer) electron-hole pairs are generated proportional to the light intensity. Electrons are collected by the X1 and X2 electrodes as a photocurrent the amount of which is proportional to the inverse electrode distance from the light spot. Analogously, hole current is collected by the rear Y1 and Y2 electrodes. Because signal is collected from electrons as well as holes, duolateral devices produce currents twice as large as the tetralateral position sensing devices which have all the four electrodes on one side of the detector. This doubling results in twice the position resolution.

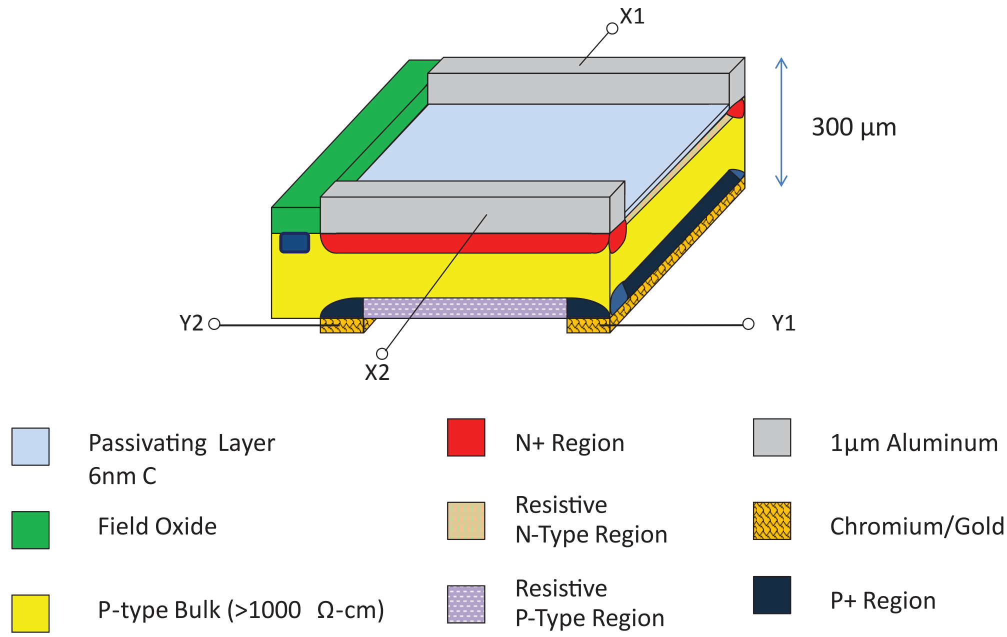


Fig. 1: Structure of the two dimensional SXUV position sensing diode developed

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The light spot position is determined by the four photocurrents measured. The beam position obtained is simply the beam centroid and thus does not depend on the beam shape, size and intensity. The beam centroid X position from the center is given by

X=(X1-X2)/(X1+X2)*L/2, where L is the distance between electrode (the active area)

Similarly, Y position is given by

Y= (Y1-Y2)/(Y1+Y2)*L/2.

Figures 2 and 3 show the linearity plots of ODD-SXUV-DLPSD obtained using 300µ wide 13.5nm beam at ALS. Step size of 50 and 1 micron is used as shown in these two figures respectively. These figures show that EUV position linearity excellent.

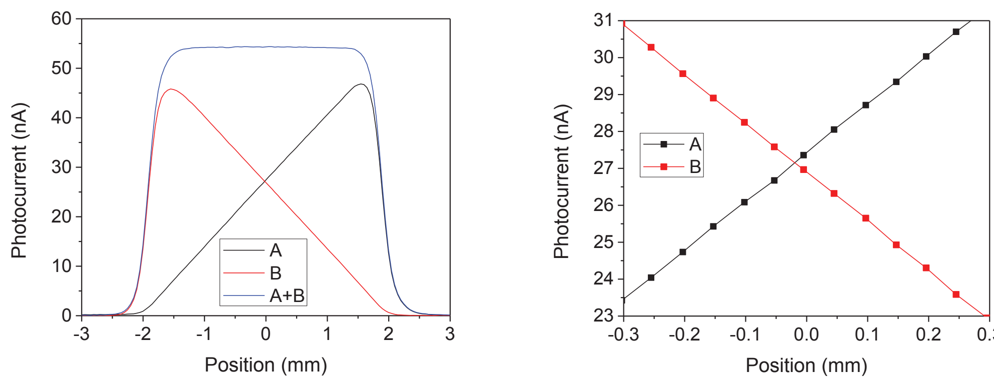

Fig. 2: Typical EUV position sensitivity of ODD-SXUV-DLPSD with 50 micron step size. Right figure is the expanded view near the center of the PSD to show linear behavior.

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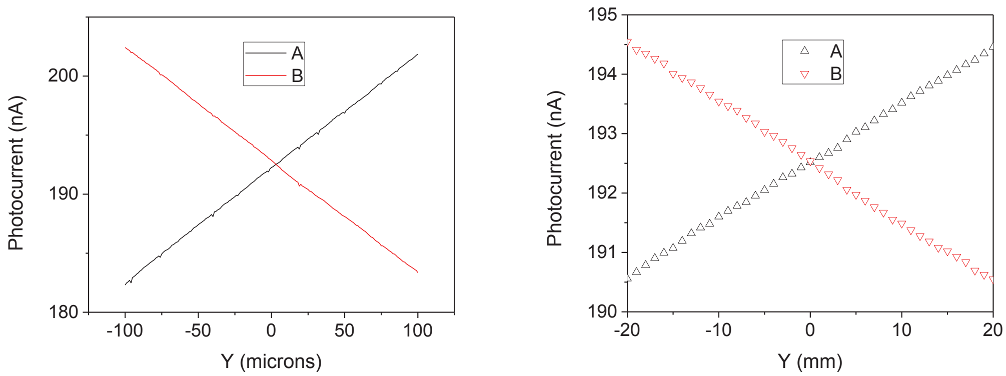

Fig. 3: Position linearity with 1 micron step size

It is known that the front silicon dioxide window in standard photodiodes causes changes in the photodiode responsivity after exposure to intense UV/EUV photons. Unparalleled radiation hardness in the SXUV devices is achieved by replacing the SiO2 window with a nitrided non-oxide window, thus eliminating UV/EUV exposure induced instability problems.

The absence of the front silicon dioxide passivating layer leads to significant surface recombination in the SXUV series diodes. This surface recombination causes significant loss in the responsivity for photons, which are strongly absorbing in silicon. Figure 4 shows the typical responsivity for the SXUV series diodes.

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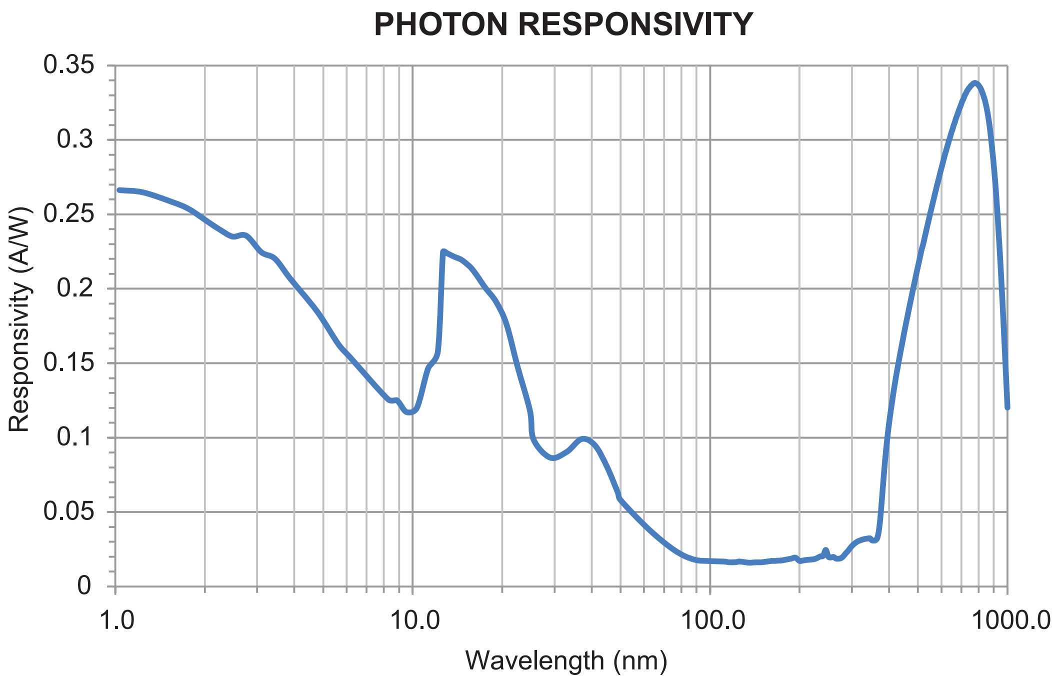

Figure 4: Typical Responsivity of SXUV-DLPSD

Fig. 5 shows the line scan of SXUV-DLPSD with 13.5 nm beam before and after exposure to 220 kJ/cm^2 of EUV dose at the center of the diode. The arrow indicates where the 50 micron X 200 micron beam was hitting the detector during the prolong EUV exposure. From Fig. 5 it may be concluded that there is less than 1% change in diode responsivity after exposure to 220 kJ/cm^2 fluence.

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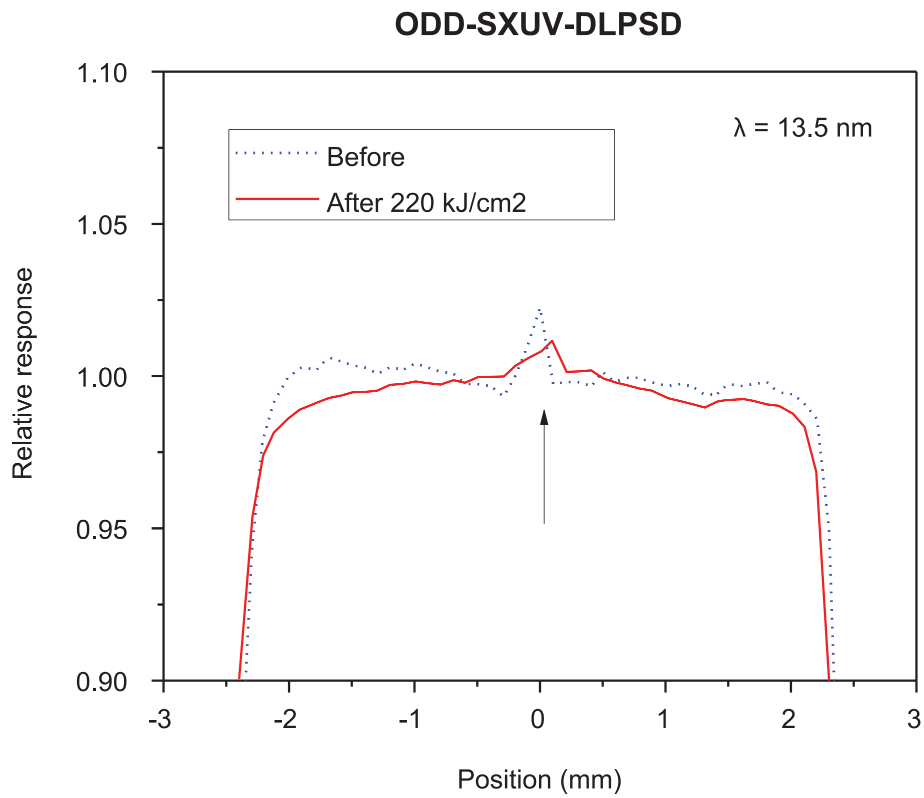

Figure 5: Line scan of SXUV-DLPSD diode with 13.5 nm beam before and after exposure to 220 kJ/cm2 of EUV dose.

No change in SXUV diode responsivity was noticed after exposure to billions of 193 and 157 nm excimer laser pulses with 100 µJ/cm2 pulse energy density.

Figure 6 shows typical capacitance vs. reverse bias voltage for a ODD-SXUV-DLPSD. The observed capacitance vs. voltage behavior is consistent with that of the abrupt (one-sided) p-n junction diode.

Figure 7 shows temperature dependence of the dark current. This indicates that the dark current doubles for every 7.5 °C rise in temperature.

Figure 8 shows the temperature dependence of the photodiode responsivity at 254 nm. Typically, the responsivity was found to increase by 0.03% per degree Celsius.

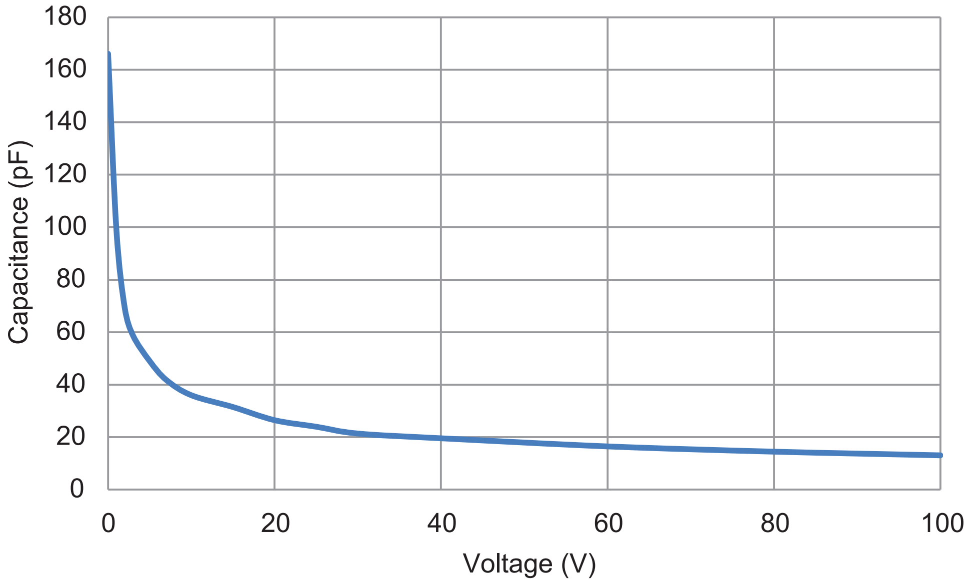

Figure.6 Capacitance as a function of bias voltage for a ODD-SXUV-DLPSD

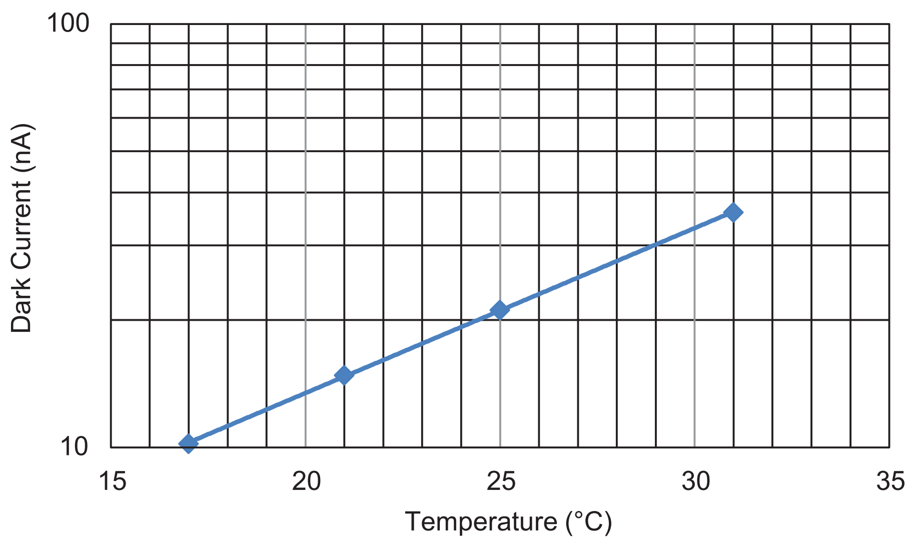

Figure. 7: Temperature dependence of dark current of the ODD-SXU-DLPSD

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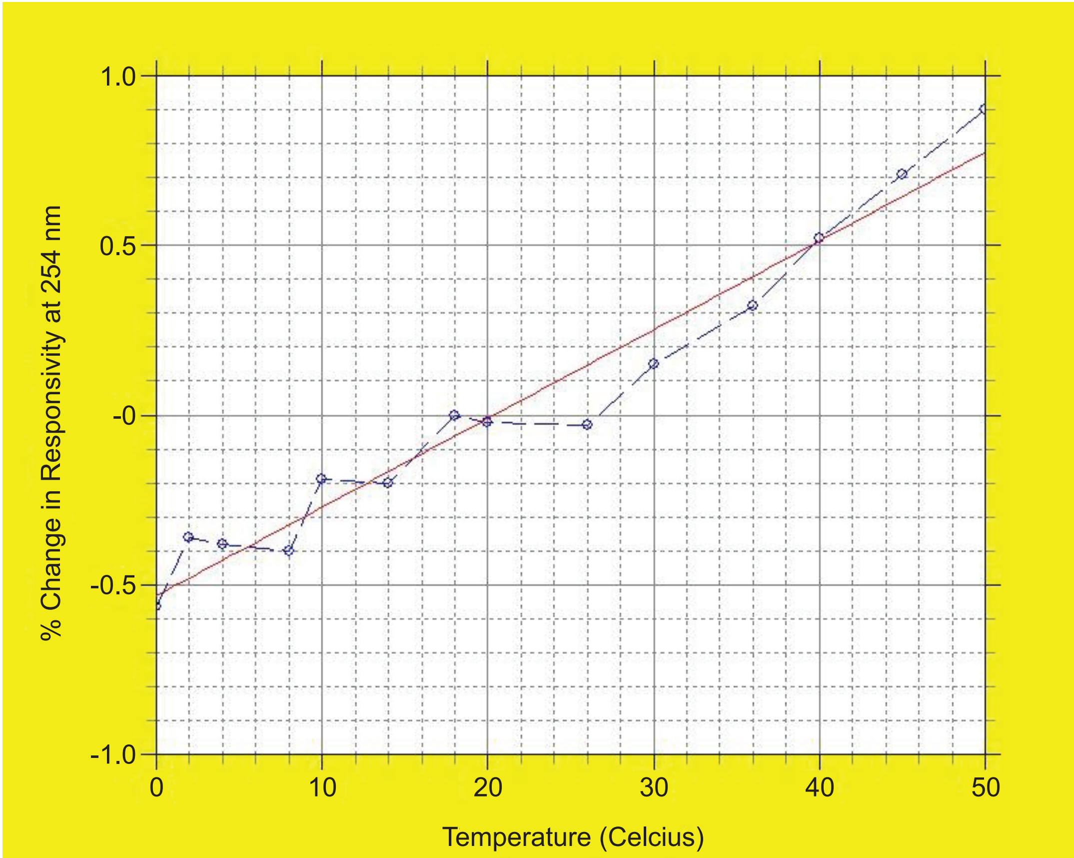

Figure. 8: Change in 254 nm responsivity of ODD-SXUV-DLPSD with temperature

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