In this data in brief (DIB) article, major photodetector (PD) characteristics of anisotype (Ag/n-TiO$_2$/p-Si/Al), isotype (Ag/n-TiO$_2$/n-Si/Ag) and M-S-M type (Ag/p-Si/Al) structures under reverse bias conditions (-1 to -5 V) over a broad spectral region (300 – 800 nm) have been presented. Critical figures of merit like current-voltage (IV), responsivity (R), detectivity (D), gain, sensitivity (S), linear dynamic range (LDR), normalized photo to dark current ratio (NPDR) and noise equivalent power (NEP) of TiO$_2$ embedded Si PDs are presented in graphical forms. I–V characteristics of PDs under dark and monochromatic illuminations (365, 425, 515 and 600 nm) were acquired by using source measure unit (Kithley). Internal gain was deduced from photoresponse spectra which were recorded with the help of Potentiostat/Galvanostat (PGSTAT302N, Autolab) under monochromatic illumination at 100 Hz chopping frequency. Quantum efficiency instrument supplied by Optosolar was utilized to accurately measure the spectral responsivity and detectivity of PDs in wide spectral region (300 – 1100 nm). Please refer our main article [1] to understand the role of functional nanocrystalline TiO$_2$ films on the performance of the photodetectors.

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1. Data

Functioning of low electron affinity nanocrystalline TiO$_2$ embedded Si PDs were studied in our recent article [1] in which Ag/n-TiO$_2$/p-Si/Al anisotype junction was found to be most efficient amongst all PDs. This DIB article includes all the analyzed PD parameters which were utilized to get insight into a role of functional TiO$_2$ film on the overall performance of Si PDs. Brieﬂy, to trace the exact contribution of a thin TiO$_2$ layer, performance of Ag/n-TiO$_2$/p-Si/Al was compared with Ag/p-Si/Al and hence responsivity (R) and detectivity (D) of such devices (D1 and D3) are presented in Figs. 1 and 2, respectively. Fig. 1 shows the variation in responsivity (in A/W) of the PDs with varying bias under the illumination of typically selected wavelengths. Viz., 360, 400, 500, 600 and 700 nm representing UV, blue, green, red and near infrared (NIR) regions, respectively. Detectivity (in Jones) variation of such devices is shown in Fig. 2 in the form of bar charts for the mentioned lights and reverse bias conditions. Photocurrent gain for all three configurations of Si PDs are presented in Fig. 3 consecutively from left to right for the devices Ag/n-TiO$_2$/p-Si/Al (D1), Ag/n-TiO$_2$/n-Si/Ag (D2) and Ag/p-Si/Al (D3), respectively. Enhancement in the photocurrent against the dark current of each PD while operated in the reverse bias can be readily looked into from these graphs. Sensitivity of any PD believed to be one of the most crucial figures of merit and thus Fig. 4 includes the sensitivity data of each PD under the monochromatic illumination from broad spectral range. Fig. 5 shows very important behavior of PDs in the form of linear dynamic range which signiﬁes the degree of linearity in PD operation against its noise. It includes LDR response of all the devices operated under reverse bias and predefined illuminating wavelengths.
Fig. 1. Variation in responsivity with applied bias and illumination conditions.

Fig. 2. Variation in detectivity with applied bias and illumination conditions.

Fig. 3. Variation in photo-gain with applied bias and illumination conditions. B-spline function has been used to show the estimated trend of the gain for each device.
Fig. 4. Variation in sensitivity with applied bias and illumination conditions.

Fig. 5. Variation in LDR with applied bias and illumination conditions.

Fig. 6. Variation in NPDR with applied bias and illumination conditions. B-spline function has been used to show the estimated trend of NPDR for each device.
Fig. 7. Variation in NEP with applied bias and illumination conditions. B-spline function has been used to show the estimated trend of NEP for each device.

Fig. 8. Recorded IV spectra of PDs under reverse bias upon illumination and dark conditions.
### Table 1
Responsivity of devices D1 and D3 under varying illumination (UV, Blue, Green, Red and NIR) and bias (−1 to −5 V) conditions.

| Applied Bias (V) | Wavelength (nm) | Responsivity (A/W) |
|-----------------|-----------------|---------------------|
|                 | 360             | 400                 | 500                 | 600                 | 700                 |
|                 | D1  | D3  | D1  | D3  | D1  | D3  | D1  | D3  | D1  | D3  |
| −1              | 0.33 | 1.11 | 0.77 | 1.77 | 3.25 | 2.17 | 4.59 | 2.6 | 5.6 | 3.19 |
| −2              | 0.64 | 1.7  | 1.37 | 3.47 | 4.03 | 6.49 | 5.77 | 6.49 | 5.6 | 6.87 |
| −3              | 2.27 | 2.59 | 3.1  | 4.53 | 5.79 | 8.73 | 8.55 | 7.44 | 9.51 | 7.38 |
| −4              | 6.36 | 3.54 | 8.68 | 5.59 | 15.67 | 11.98 | 20.71 | 8.64 | 23.13 | 10.49 |
| −5              | 5.7  | 1.9  | 11.2 | 6   | 23.56 | 13   | 24.89 | 9.1 | 12.19 | 10.4 |

### Table 2
Detectivity of devices D1 and D3 under varying illumination (UV, Blue, Green, Red and NIR) and bias (−1 to −5 V) conditions.

| Applied Bias (V) | Wavelength (nm) | Detectivity ($\times 10^{10}$ Jones) |
|-----------------|-----------------|--------------------------------------|
|                 | 360             | 400                 | 500                 | 600                 | 700                 |
|                 | D1  | D3  | D1  | D3  | D1  | D3  | D1  | D3  | D1  | D3  |
| −1              | 7.14 | 5.54 | 16.4 | 8.81 | 69.7 | 10.8 | 98.6 | 13 | 120 | 15.9 |
| −2              | 12.8 | 5.91 | 27.6 | 12.1 | 81.4 | 22.6 | 116 | 22.5 | 113 | 23.9 |
| −3              | 45.3 | 7.32 | 62   | 12.8 | 116 | 24.6 | 171 | 21 | 190 | 20.8 |
| −4              | 127  | 10   | 173  | 15.8 | 312 | 34.0 | 412 | 24.5 | 460 | 29.7 |
| −5              | 113  | 5.39 | 222  | 17   | 467 | 36.9 | 493 | 25.8 | 242 | 29.5 |

### Table 3
Photogain of devices D1, D2 and D3 under varying illumination (UV, Blue, Green and Red) and bias (−1 to −5 V) conditions.

| Applied Bias (V) | Wavelength (nm) | Gain |
|-----------------|-----------------|------|
|                 | 360             | 400             | 500             | 600             |
|                 | D1  | D2  | D3  | D1  | D2  | D3  | D1  | D2  | D3  |
| −1              | 1.04 | 0.46 | 23.80 | 3.13 | 2.89 | 2.59 | 3.68 | 1.23 | 6.70 |
| −2              | 5.24 | 1.45 | 18.20 | 19.60 | 11.08 | 8.39 | 30.03 | 5.51 | 15.47 |
| −3              | 15.83 | 8.44 | 16.91 | 49.18 | 21.87 | 9.30 | 28.01 | 13.93 | 13.53 |
| −4              | 39.69 | 16.77 | 24.64 | 58.69 | 22.29 | 9.76 | 28.83 | 16.41 | 14.54 |
| −5              | 45.65 | 20.68 | 17.07 | 60.43 | 22.71 | 11.02 | 28.92 | 16.85 | 15.56 |

### Table 4
Sensitivity of devices D1, D2 and D3 under varying illumination (UV, Blue, Green and Red) and bias (−1 to −5 V) conditions.

| Applied Bias (V) | Wavelength (nm) | Sensitivity ($\times 10^2\%$) |
|-----------------|-----------------|-----------------------------|
|                 | 360             | 400             | 500             | 600             |
|                 | D1  | D2  | D3  | D1  | D2  | D3  | D1  | D2  | D3  |
| −1              | 0.04 | −0.54 | 22.80 | 2.13 | 1.89 | 1.59 | 2.68 | 0.23 | 5.70 |
| −2              | 4.24 | 0.45 | 17.20 | 18.60 | 10.08 | 7.39 | 29.03 | 4.51 | 14.47 |
| −3              | 14.83 | 7.44 | 15.91 | 48.18 | 20.87 | 8.30 | 27.01 | 12.39 | 12.53 |
| −4              | 38.69 | 15.77 | 23.64 | 57.69 | 21.29 | 8.76 | 27.83 | 15.41 | 13.54 |
| −5              | 44.65 | 19.68 | 16.07 | 59.43 | 21.71 | 10.02 | 27.92 | 15.85 | 14.56 |
Quantitatively analyzed normalized photo to dark current ratio (NPDR) and noise equivalent power (NEP) are shown in Figs. 6 and 7, respectively. Variation in NPDR and NEP with applied bias is highly important to trace out the ability of designed PD in handling the noise level and thus enabling a quicker response to the actual signal. At the end, IV characteristics of each of the PDs under varying illumination and dark conditions are shown in Fig. 8.

All the acquired raw data and analyzed figures of merit like responsivity, detectivity, gain, sensitivity, LDR, NPDR and NEP of designed PDs are given in Tables 1 to 7, respectively.

### 2. Experimental design, materials, and methods

Monocrystalline Si wafers of p and n-type were used as substrates to fabricate PDs of the configurations discussed in the main manuscript [1]. Ohmic metal contacts on such Si wafers were obtained by sputtering thin layers of aluminum (Al) and silver (Ag), appropriately. High purity Ti (99.995% pure,
Sigma Aldrich) was sputtered at constant power of 150 W and 5 mT working pressure with predefined Ar flow for 15 min. To convert Ti thin films into titanium dioxide (TiO₂), Ti coated Silicon films were post treated in vacuum furnace at 700 °C for 10 min.

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Conflict of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

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