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Comment on “Superior Photodetectors Based on All-Inorganic Perovskite $CsPbI_3$ Nanorods with Ultrafast Response and High Stability”

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Highly sensitive and fast photodetection is a cornerstone of optical telecommunication and indispensable for emerging quantum communication technologies. Accordingly, it is in the focus of active research. In a recent article, “Superior Photodetectors Based on All-Inorganic Perovskite $CsPbI_3$ Nanorods with Ultrafast Response and High Stability”,[1] Yang *et al.* claimed to have fabricated a photodetector with $R = 2920$ A/W responsivity based on a single $CsPbI_3$ nanorod deposited on a SiO_2 substrate and contacted by 30 nm thick thermally evaporated gold contacts. The authors come to this conclusion by measuring $I_{PH} = 31$ nA photocurrent at 2 V bias voltage while the device was illuminated by $P = 10.69$ mW/cm^2 light with 405 nm wavelength. Yang *et al.*[1] also claimed that the photodetectors' detectivity reached $D^* = 5.17 \times 10^{13}$ Jones. I will argue that the data reported by Yang *et al.*[1] are insufficient to support these claims: a realistic estimate of R and D^* is 967 A/W and 1.7×10^{13} Jones, respectively.

The calculation of R by Yang *et al.*[1] was performed based on eq 1 of the article:[1] $R = I_{PH}/(PA)$, where I_{PH} and P are the measured photocurrent and incident light power, respectively. A is the effective area of the device. The calculation of D^* was based on eq 4 of the article:[1]

$$D^* = \frac{R\sqrt{A}}{\sqrt{2eI_{off}}}$$

where R is the responsivity, e is the elementary charge, I_{off} is the measured dark current, and A is the effective area of the device. As clearly seen from these equations, both R and D^* critically depend on A; neither its magnitude nor the method with which it was obtained is reported in the article[1] or in the Supporting Information. Substituting the experimentally observed quantities, I_{PH} and P, to eq 1 yields $A_{eff} = 9.93 \times 10^4$ nm^2. This is the effective area estimated by Yang *et al.*[1] This is significantly smaller than $A_{avg} = 30 \times 10^4$ nm^2, the average cross section of the individual nanorods reported by Yang *et al.*,[1] or the $A_{avg} = 15.4 \times 10^4$ nm^2 device shown in Figure 2C. Accordingly, the calculation of Yang *et al.*[1] significantly overestimates R and D^*. The realistic R and D^* based on the average rod cross section, A_{avg}, is $R_{avg} = 967$ A/W and $D_{avg}^* = 1.7 \times 10^{13}$ Jones. Furthermore, we must note that gold is a bad reflector at wavelengths less than 500 nm, responsible for its well-known yellow color.[2] In particular, at 405 nm, the reflectivity is 0.1−0.2, with penetration depth exceeding 100 nm.[2] The effective light-sensitive area of photodetectors working in the UV spectral range cannot be defined by thin gold masks.

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