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Peer Review

Review of: "A High-Performance All-Silicon Photodetector Enabling Telecom-Wavelength Detection at Room Temperature"

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A High-Performance All-Silicon Photodetector Enabling Telecom-Wavelength Detection at Room Temperature

M. S. Shaikh, M.-T. Catuneanu, A. Echresh, R. Li, S. Wen, G. Godoy-Pérez, S. Prucnal, M. Helm, Y. M. Georgiev, K. Jamshidi, S. Zhou, and Y. Berencén.

This is very interesting work on waveguide photodiodes on Si to operate with sufficient responsivity in the C-Band optical wavelengths. The authors have done a commendable job in the design, fabrication, and measurement of the device; however, there are a few loose ends that need to be corrected for the clarity of the document for the reader, as listed below:

1. This work starts with a wide introduction on the benefits of this device for optical communications using Si-PICs. But the device uses a 9 V bias, which is not compatible with present-day biases used in microelectronic circuits. It is obvious that for lower biases, the efficiency would decrease, and probably the bandwidth of 5.9 GHz would be reduced to be useless in 10 Gbps optical communication applications.

2. In Fig. 1, the spacing between the waveguide rib and the doped regions is shown to be 550 nm, whereas the rib width is 450 nm, but the diagram would give a misconception to the reader as the rib is shown to be disproportionately wide. This may have been avoided in Fig. 1(d) for want of space, but it must be shown with proportionate dimensions in Fig. 1(c).

3. Information missing:

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a) What is the grating width (also the maximum taper width) and the length of the grating used? {supplementary data not opening up}. This has implications for the total insertion loss, as the guided loss is as high as 10 dB. Then what is the external responsivity?

b) What is the length of the taper? The implication is that can the loss be made better with an exponential taper?

c) What is the length of the waveguide after the taper to the detector? Is it the same for lengths L1-L4?

4. The authors quote ref. 12 for a 200 ps carrier lifetime, but the same paper says that there are two decay time constants: 1-200 ps and another of 1 ns. Please clarify in the text why the lower value is chosen.

5. The device bandwidth quoted is obviously RC-time constant limited; however, as the power increases, the deep level states would be further populated, and the velocity of the carriers would decrease due to slow relaxation times of deep level states. Hence, for those situations, the detector speed would no longer remain RC-time constant limited. Comments are needed on this, as that would have implications on the comments made in (1) above.

6. As this manuscript deals with only a single device and does not even show an "interdigitated" device, I find no reason or utility in calling the device under study "interdigitated," and reference 19 only suffices. Hence, in all nomenclature as "interdigitated …," the "interdigitated" word should be removed to reduce confusion.

7. The NEP measurement was done at 70 Hz, as quoted in "A 1550 nm laser, modulated with a 70 Hz square wave." Maybe this is done to prevent noise from entering the measurement source. However, the question then arises if this NEP holds for the bandwidth of 5.9 GHz quoted. Please clarify.

8. Page 12: "Consequently, such APDs could achieve sufficient responsivity at relatively low gain levels, enabling them **to exceed the bandwidth limitations** of conventional high-speed receivers." APDs usually lower bandwidths rather than improving them. So this statement is incorrect. The "enabling them **to exceed the bandwidth limitations**" should be removed.

Declarations

Potential competing interests: No potential competing interests to declare.