$PtSe_2$-Si Photodiodes enabled by Selenization of Platinum Films on Silicon

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The semi metallic noble metal dichalcogenide $PtSe_2$ transitions to a semiconductor when isolated to a few layers state, making it useful for both contact and channel materials. For device applications it also has the advantage of relatively low synthesis temperature of <450°C, below the CMOS back-end-of-line (BEOL) limit. Mono- and few-layer $PtSe_2$ are desirable because of their useful bandgaps, high carrier mobility, piezoresistive behaviour and high air-stability [1,2].
$PtSe_2$ / Si Diodes have been used for IR Sensors, these typically relied on transfer processes [3,4]. Here we show $PtSe_2$-Si-Schottky diodes can be fabricated by deposition of Pt films directly on Si and subsequent conversion to $PtSe_2$. With Raman, AFM and XPS measurements we confirm successful growth of the $PtSe_2$ on both SiO_2 and Si surfaces without significant deviations in film quality. The fabricated devices show distinct photoconduction in a wide spectral region above the Si bandgap. The thin $PtSe_2$ layer contributed to a weak photo response below the Si bandgap even in the IR region. The growth of $PtSe_2$ directly on silicon is a major advantage over IR sensor produces by transfer technologies.

References

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[3] C. Yim et al., Nano Lett., vol. 18, no. 3, (2018), pp. 1794–1800
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Figures

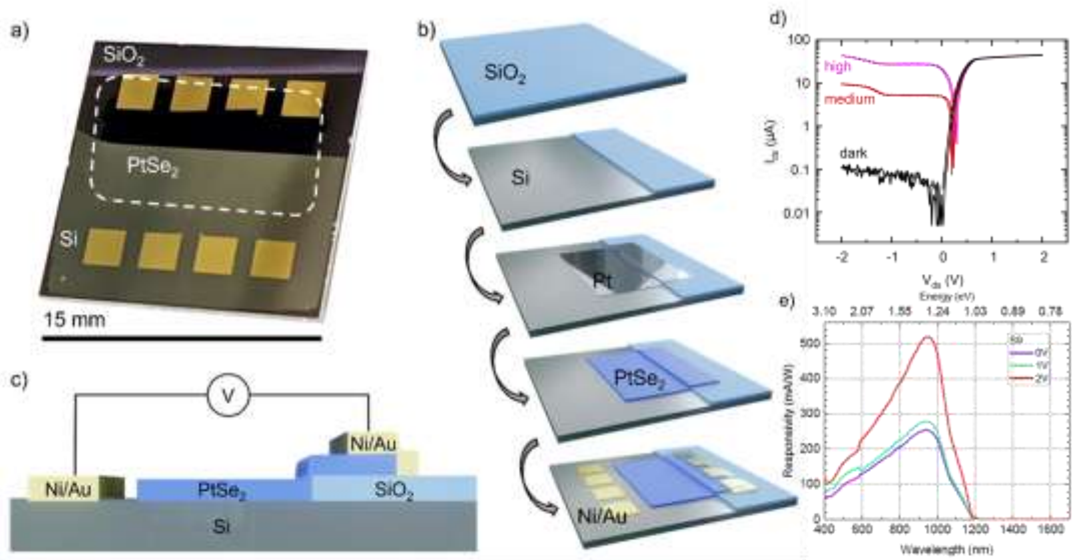

Figure 1: (a) Photo of a PtSe2-Si-Schottky diode. (b) Schematic highlighting the fabrication steps of the $PtSe_2$-Si-Diode. (c) Schematic edge view of the diode. (d) Bipolar I-V curves of the diode in dark and illuminated states of increasing intensity. (e) Spectral response of a Diode based on a 5 nm thick $PtSe_2$ layer.