GeSn/Ge multiple-quantum-well short-wave infrared photoconductors on silicon

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GeSn alloys have recently attracted increasing attention for Si-based short-wave infrared (SWIR) photodetectors for various applications such as telecommunications, imaging, and gas sensing [1-3]. Introducing Sn into Ge can significantly lower the direct bandgap energy, extended the absorption edge of the material into longer wavelengths [2]. This has led to the development of GeSn-based photodetectors that can operate in the SWIR region reaching beyond 2.2 μm [2, 3]. Here we present the growth, fabrication, and characterization of $Ge_{0.92}Sn_{0.08}$/Ge multiple quantum well (MQW) phoconductors on Si substrates .

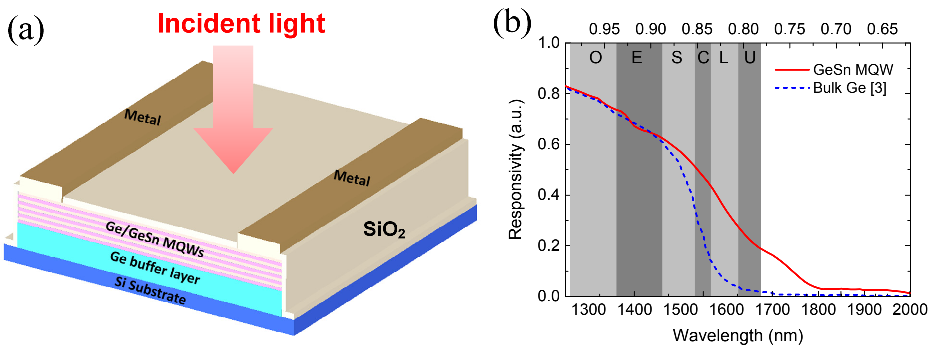

Fig. 1 (a) Schematics of the fabricated GeSn/Ge MQW photoconductors on Si substrates. (b) Measured responsivity spectrum of the GeSn/Ge MQW photoconductor compared to a Ge reference device.

The samples used in this study were grown by solid-source molecular beam epitaxy (MBE). A 200-nm-thick, fully-strained Ge buffer layer was first grown on Si substrate as the virtual substrate. Subsequently, ten pairs of $Ge_{0.92}Sn_{0.08}$/Ge quantum wells were grown with a thickness of 10/15 nm. The material was fabricated into normal incident metal-semiconductor-metal (MSM) photoconductors using standard CMOS process flows. A schematic plot of the fabricated device is displayed in Fig. 1(a). Figure 1(b) shows the measured optical response of the device, compared with a Ge reference device [3]. It is clear that detection cutoff wavelength is extended from 1550 nm to 1800 nm due to the incorporation of Sn into the MQW. The results indicate that this device can cover the entire telecommunication windows (1260-1675 nm), and thus could has important applications for telecommunication and on-chip optical interconnections.

References

1. B. Conley *et al.*, Opt. Express **22**, 15639–15652 (2014).

2. Y. H. Peng *et al.*, Appl. Phys. Lett. **105**, 231109 (2014)

3. M. Oehme *et al.*, Appl. Phys. Lett. **101**(14), 141110 (2012).

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