Light Emission from GeSn Vertical Cavity on Silicon-on-Insulator

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GeSn alloys have been considered as a potential candidate for efficient light emitting materials for CMOS-compatible light sources due to the direct-bandgap nature for efficient electron-hole recommendation. Recently, optically-pumped GeSn lasers [1] and electrically-injected GeSn vertical-cavity light emitter [2] have been demonstrated. Here we present a photoluminescence (PL) study of GeSn vertical cavity on silicon-on-insulator (SOI) platform.

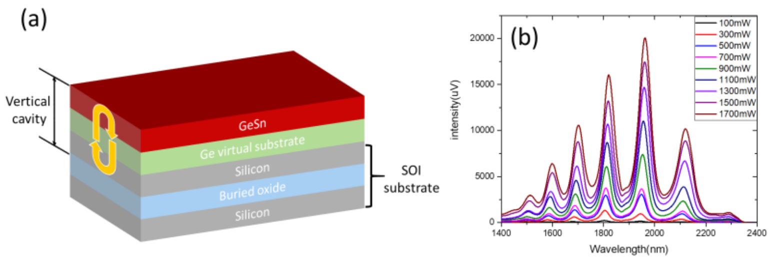

Fig. 1. (a) Layer structure of the GeSn vertical cavity grown on a SOI substrate. (b) Room-temperature PL spectra under various laser powers.

The sample used in this study was grown on a SOI substrate using low-temperature molecular-beam-epitaxy techniques. The structure consists a 200-nm-thick, fully strain-relaxed Ge virtual substrate (VS) and a 400-nm-thick $Ge_{0.955}Sn_{0.045}$ active layer that us coherent to the underlying Ge VS. The thicknesses of the top Si layer and the buried-oxide (BOX) layer are 2.5 μm and 1 μm layer, respectively. The BOX layer serves as the bottom reflector, thus forming a vertical cavity. Figure 1(b) shows the room-temperature PL spectra from the GeSn vertical cavity using a 532 nm CW laser with different optical powers. Several emission peaks are observed, showing evidence for Fabry-Perot cavity modes. The strongest emission peak is ~1960 nm, corresponding to a bandgap energy of 0. 632 eV. As the excitation power increases, the intensity of the emission peak increases, as well as the ratio of peak intensity and valley intensity. These results show the absorption coefficient in the GeSn cavity is reduced, therefore showing great promises to achieve CW room-temperature optical gain for laser applications.

References

1. S. Wirths *et al.*, Nat. Photonics 9, 88−92 (2015).
2. B. J. Huang *et al.*, ACS Photonics 6, 1931−1938 (2019).