Amplified Spontaneous Emission from GeSn/Ge heterostructures

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GeSn alloys have been emerging as a new material system for efficient Si-based light emitters [1]. Adding Sn into Ge can effectively transfer the band structure from indirect to direct, making population inversion possible to achieve optical gain. Enhanced photoluminescence (PL) [2], electroluminescence (EL) [3] have been observed, and lasing action from GeSn Fabry-Perot cavities have been recently achieved [4]. However, the luminescence properties of GeSn have not been fully understood. In this paper, we present preliminary results on amplified spontaneous emission (ASE) from GeSn/Ge heterostructures.

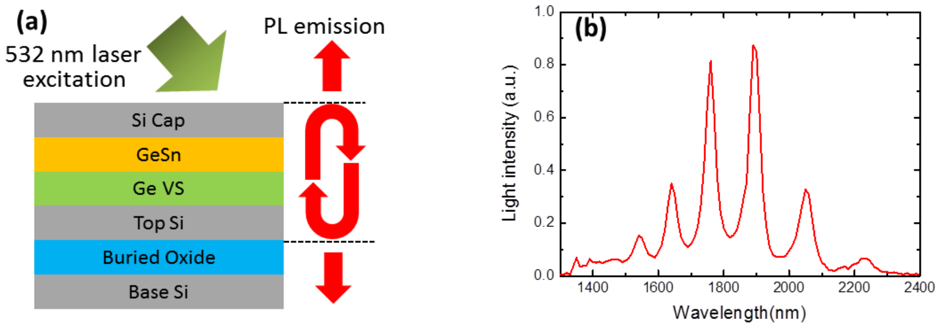

Fig. 1. (a) Schematic layer structure and (b) room-temperature ASE spectrum of the grown samples.

The samples used in this study were grown on silicon-on-insulator (SOI) substrates with a top Si thickness of 2.5 μm and a buried insulating silicon dioxide (BOX) layer of 1 μm. A 120 nm thick Ge virtual substrate (VS) was first grown using a two-step growth technique. Subsequently, a 200 nm thick $Ge_{0.95}Sn_{0.05}$ layer was grown at 150℃, followed by a 3-nm Si cap layer. A schematic plot of the layer structure is plotted in Fig. 1(a). The semiconductor layers were sandwiched between the low refractive index BOX layer (n=1.45) and air (n=1), forming a cavity structure. To investigate the light emission properties, room-temperature PL experiments were conducted using a 532 nm green laser as the excitation source to obtain the ASE spectrum of the grown samples; the results are depicted in Fig. 1(b). Clear multiple emission perks are observed due to the cavity effects. The strongest emission peak is located at 1890 nm, indicating a reduced direct bandgap due to Sn-alloying. The spacing between emission peaks is about 130 nm. These results demonstrate ASE from the vertical GeSn/Ge heterostructures and are useful to further study the light-emission properties of GeSn alloys.

References

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