Lasing characteristics of SCH-MQW LD grown on directly bonded InP/Si substrates with gas out channel

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I. INTRODUCTION

Integrating InP-based optical devices on Si substrates is vital for high-speed optical communication. We developed a method using hydrophilically bonded InP and Si substrates, introducing gas out channels to reduce void density at the bonding interface. This paper presents the void distribution and laser performance on these modified substrates.

II. METHODS

The gas out channel (GOC) was fabricated by wet chemical etching and photolithography. The patterned trenches were 10 m width, 50-200 m pitch and 259 nm depth. On this patterned substrate, 1 m thickness InP film was hydrophilically bonded, and annealed at 400 degree-C under nitrogen flow as shown in Fig.1. Then SCH-MQW LD layers as shown in Fig.2 were grown by using MOVPE where growth temperature was 650 degree-C and pressure was 8kPa.

III. RESULTS

Fig. 3 illustrates the voids occupancy versus trench pitch, showing a decrease with GOC implementation, especially at 50 μm pitch.

Fig.4 shows the threshold current density of SCH-MQW LD grown on GOC Si substrate, planar Si substrate and InP substrate. By introducing the GOC in Si substrate, the voids occupancy was reduced, and the threshold current density was decreased by comparing the planar Si substrate. Furthermore, the threshold current density of GOC substrate was almost comparable with InP substrate LD.

IV. CONCLUSION

Gas out channel silicon substrate is effective to reduce the voids for the hydrophilic bonding of InP and Si. We have remarkably reduced the threshold current density in SCH-MQW LDs grown on silicon substrate with GOC.