Grating Coupling Coefficient Reduction of Membrane III-V Lasers on Silicon Using Splitted Surface Grating

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Silicon photonics industries are rapidly growing, and various research demonstrations / commercial products are available. There are a lot of reports integrating III-V-based materials on Si to obtain on-Si light sources. We have been developing III-V on Si lasers with integrating InP-based membrane on Si. Optical cavities of our membrane lasers consisted of surface gratings. We could easily obtain large coupling coefficient, and short-cavity directly modulated lasers were reported [1]. To use membrane lasers as bias light sources, we need to use longer active region with relatively lower grating coupling coefficient. Previously we used SiN-based grating to lower coupling coefficient [2]. Here, we use conventional surface grating with modifying etching shape to lower coupling coefficient.

Figure (a) shows top view and cross section schematic of conventional and proposed membrane structure. As a top view, simple line-and-space structure was formed as a conventional one. On the other hand, grating was partially not etched on the active region in the proposed one. We define the width of non-etched region as “split width” in this paper. Figure (b) shows grating coupling coefficient versus split width. By increasing split width, coupling coefficient monotonically decreased.

Figure (c) shows lasing spectra of 200-μm-long lasers, where split width was 0.2 and 0.8 μm as blue and red plot, respectively. When the split width was 0.2 μm, the device exhibited multi-mode lasing because of large κL. By employing split width of 0.8 μm, we could achieve stable single-mode lasing from 200-μm-long cavity lasers.