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A Low Cost Gain-Coupled Distributed Feedback Laser Based on Periodic Surface p-Contacts

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Abstract : The distributed feedback (DFB) lasers are indispensable in optical phase array (OPA) used for light detection and ranging (LIDAR) techniques, laser communication systems and integrated optics, thanks to their stable single longitudinal mode and narrow linewidth properties. Traditional index-coupled (IC) DFB lasers with uniform gratings have an inherent problem of lasing two degenerated modes. Phase shifts are usually required to eliminate the mode degeneration, making the grating structure complex and expensive. High-quality antireflection (AR) coatings on both lasing facets are also essential owing to the random facet phases introduced by the chip cleavage process, which means half of the lasing energy is wasted. Gain-coupled DFB (GC-DFB) lasers based on the periodic gain (or loss) are announced to have single longitudinal mode as well as capable of the unsymmetrical coating to increase lasing power and efficiency thanks to facet immunity. However, expensive and time-consuming technologies such as epitaxial regrowth and nanoscale grating processing are still required just as IC-DFB lasers, preventing them from practical applications and commercial markets. In this research, we propose a low-cost, single-mode regrowth-free GC-DFB laser based on periodic surface p-contacts. The gain coupling effect is achieved simply by periodic current distribution in the quantum well caused by periodic surface p-contacts, introducing very little index-coupling effect that can be omitted. It is prepared by i-line lithography, without nanoscale grating fabrication or secondary epitaxy. Due to easy fabrication techniques, it provides a method to fabricate practical low cost GC-DFB lasers for widespread practical applications.

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