A regrowth-free, facetless multiple quantum wells AlInGaAs semiconductor laser suitable for photonic integration

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Abstract: A facetless, semiconductor laser suitable for photonic integration is presented in this paper. The laser fabrication process employs contact lithography and regrowth-free process. Moreover, the laser cavity is monolithically integrated with a semiconductor optical amplifier.

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1. introduction

Photonic integrated circuits (PIC) based on active InP provide a variety of photonic building blocks that cannot be implemented in passive material. However, InP PICs lack the leverage of the existing micro-electronic infrastructure and silicon photonics industry. Thus, their commercial use is limited by economic factors, such as effective mass production, lead time and fabrication complexity.

As a result, a generic InP integration technology initiative to share the cost between interested parties has been developed in order to push the industry forward [1]. At this stage, further cost reduction, shorter processing times, and simplified fabrication processes are still necessary to extend the industry to the next level to encourage more commercial use. Laser cavities that can be fabricated with contact lithography and regrowth-free processes drastically reduce the overall time and cost of the fabrication process. These lasers have attracted considerable interest due to their relatively simple fabrication process and have demonstrated great potential as cost effective tunable laser sources for telecommunication applications [2].

In this paper, we present a facetless semiconductor laser suitable for photonic integration fabricated using contact UV lithography in a regrowth-free process. The laser cavity consists of 2 higher order grating pit mirrors coupled to an active ring resonator via a half-wave coupler (HWC) [3].

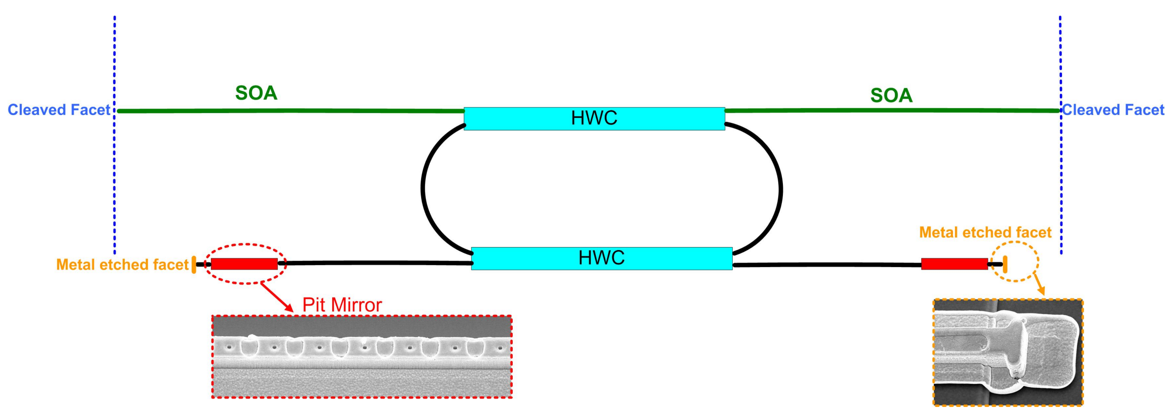

Fig. 1. Laser cavity design

2. Cavity fabrication and design

The laser was fabricated using standard n-doped multiple quantum well epitaxial wafers purchased from IQE. Four lithography steps were used to define the ridge, etch depth, metal opening, and metal lift-off. Top p-metal and back side n-metal was 20:500 Ti:Au and 20:300 Ti:Au respectively.

The laser cavity design is shown in Fig.1. Two pit mirrors [4] are used to create a narrow bandwidth resonator, and the light from this cavity is then coupled to a ring laser via a HWC. These coupled resonators enhance and amplify the desired mode while suppressing the remainder. Laser emission is coupled to a waveguide that acts as a semiconductor optical amplifier (SOA) and an output waveguide. The output is then coupled to an optical spectrum analyzer via a lensed fibre.

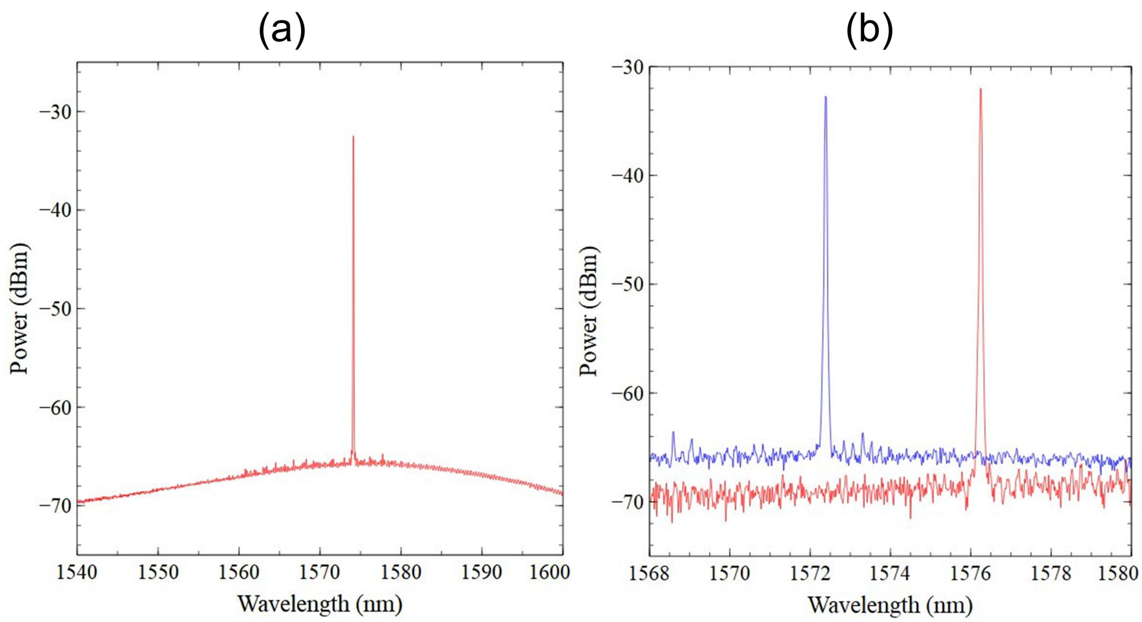

Fig. 2. (a) single mode output, (b) continuous tuning across 4 nm

Fig.2 (a) shows the single mode output of the laser, while Fig.2 (b) shows a fine tuning example of laser, which can continuously cover around 4 nm by changing the injected current into the different sections of the cavity. The single mode showed a 0.098nm/degree shift over a 15 degrees increase in temperature, without any mode hopping.

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