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Mid-IR integrated cavity based on Ge-rich graded SiGe waveguides with lateral Bragg grating

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Abstract: We report the design of a Bragg-mirror based Fabry-Perot cavity integrated on SiGe waveguides working at 7.25 μm. The demonstration of such resonant structures will be a major step forward for sensing applications in mid-infrared.

OCIS codes: (130.0130) Integrated optics; (130.3120) Integrated optics devices

1. Introduction

Photonic integrated circuits (PICs) in the mid-infrared (MIR) have attracted a lot of interest, particularly for novel applications in medical diagnosis, chemical and biological sensing, free-space telecommunication or security [1]. The Ge-rich SiGe graded waveguides benefit from a wide transparent window, strong 3rd order nonlinearity, broadband dispersion engineer-ability [2] and compatibility with silicon photonics. Such structures have revealed to be a promising platform to realize complex mid-infrared PICs in a wide wavelength range. For example broadband Mach Zehnder interferometers have been experimentally demonstrated from 5.5 to 8.5 μm wavelength, working in both quasi-TE and TM polarizations [3]. However, some key devices are still required in order to demonstrate the full potential of this platform, among which resonant structures that will be crucial for sensing applications where strong light-matter interaction is desired. In this context, a Fabry-Perot cavity using lateral Bragg grating mirrors might be a promising option to develop mid-IR SiGe cavities with high performance. In this work we design Bragg grating mirror based on graded SiGe waveguide and evaluate the performances of integrated cavities around 7.25 μm.

2. Design and simulation

The waveguide design is based on a 6 μm-thick graded Si1-xGex rib waveguide. As illustrated in Fig 1(a) the Bragg mirror is obtained by a lateral corrugation of the waveguide width, permitting simple fabrication using a single etching step to define simultaneously the waveguide and Bragg mirrors, with 1 μm grating period, 4 μm etching depth and with a duty cycle of 50%. The mirror reflectivity at the central wavelength is up to 95%, using a 200 μm-long grating, and the spectral bandwidth is 62 nm. The transmission of a 600 μm-long cavity using these mirrors is plotted in Fig 1(b). Moreover, the theoretical Q-factor around 1×104 is expected assuming 1dB/cm propagation losses.

3. References


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