Photonic Crystal Nanobeam Laser

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High quality factor optical nanocavities have attracted much attention in different applications such as photonic integrated circuit [1]. Recently, photonic crystal nanocavities have become important because of the ability to confine light in a sub-wavelength scale, and have been reported as devices as low-threshold lasers, optical switching and optical sensors [2,3]. In addition, modified one-dimensional (1-D) photonic crystal nanobeam cavity, as shown in Fig.1, has been demonstrated owning high quality factor (> 10\textsuperscript{6}) and small mode volume (~1.2 [\lambda/n]\textsuperscript{3}). Here, we show the coupled photonic crystal nanobeam laser consisting of two parallel nanobeam cavities separated by an air gap, as shown in Fig. 2 (a). By varying the gap width d, the wavelength spacing between the two coupled lasing modes can be tuned. Coupled photonic crystal nanobeam cavities were fabricated and characterized, as shown in Fig.2 (a), for laser. The coupled photonic crystal nanobeam cavities are separated by a gap width. Experimentally, as shown in Fig.3, by varying the gap width, the lasing action of the coupled PhC nanobeam cavities was observed. Besides this, the lasing wavelength of two major resonant modes can be controlled by tuning the gap width. The experimental results of the coupled modes of the coupled photonic crystal nanobeam cavities are in a good agreement with the 3D-FDTD simulation results.

Keywords: photonic crystals, nanobeam cavity, laser

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Fig.1 (a) the schematic diagram of a single PhC nanobeam cavity. (b) The calculated E-field distribution of the single PhC nanobeam cavity. (b) The SEM image of the fabricated single PhC nanobeam cavity.
Fig. 2 (a) The SEM image of the fabricated coupled PhC nanobeam cavities, the lattice constant and the gap width are 465 nm and 0.1a respectively. (b) and (c) are the calculated E-field distribution of the even and odd modes.

Fig. 3 The lasing spectrum of the coupled PhC nanobeam cavities with the gap width (0.5a). The inset plot is the light-in and light-out curves of the two lasing modes.

REFERENCES