Low-power consumption in either optoelectronic or photonic circuits is crucial for future nanotechnology. In the last decade much of researcher’s concerns have been focusing on this issue to find reliable system fitting their demands. In order to meet these challenging demands, novel optical nanostructures that strongly confine optical fields are essential. In order to minimise losses and their dependence on the proposed photonic crystal circuit (PIC), we present an active defect based optical circuit. Nonlinear optical materials use the nonlinear dependence of the refraction index on the electric field to produce different frequencies. The nonlinear effect can be used to design different kinds of photonic components such as dense multiplexers/demultiplexers and transmitters/receivers. Using a two-dimensional 2D Finite-difference time-domain (FDTD) method, we present an extensive study of a new type of the wavelength multiplexer system. In this study self focusing and defocusing are considered. Coupling efficiency between various components integrated in a single chip is investigated. It is worth mentioning that Ultra-Dense Wavelength Division Multiplexing system (UDWDM) is of high increasing demand since it provides a large broad spectrum that satisfies huge number of users world-wide. The UDWDM plays a central role in optical interconnection between various chips required for high-dense integrated system [1-3]. Such systems can be used in the high-capacity optical fibre communication systems.

In this study, the proposed approach is based on using an ultra-narrow optical filter together novel modulation formats for 10 Gb/s UDWDM transmission systems. The photonic crystal used here used as the background medium consists of air cylinders etched on silicon with refractive index 3.4. The air cylinders are squarely packed with a lattice constant $a$. The refractive index of the background is 3.4. Figure 1 shows the schematic of the ultra dense waveguide photonic crystal composed of two photonic crystal waveguides (PCWs) which are evanescently coupled. The lower waveguide contains a line of defects with nonlinear medium.

The band structure is calculated and illustrated in figure 2. It can be seen that a transverse magnetic (TM) band gap is between $0.31a/\lambda$ to $0.44a/\lambda$. Transmission spectrum through the PCWs is illustrated in Figs. 3 and 4. One can see that high transmission about 100% corresponds to the PCW incorporating nonlinear material. However, transmission which is about 80% corresponds to the PCW when the nonlinear material is not incorporated. It can be observed that both spectra minimum has been achieved at normalised frequency equal to 0.35 $a/\lambda$. The TM mode contour plot, when the upper PCW is excited, has been illustrated in figure 5. It can be anticipated that the optical mode is evanescently coupled into the lower waveguide.

References

Figure captions:

[Figure 1, Figure 2, Figure 3, Figure 4, Figure 5]