Chapter 4 CONCLUSION

In this thesis, we present an analysis of one-dimensional photonic crystal with perfect and defect structure by FDTD method. We get the transmission spectrum, dispersion relation of Re[K] and the behavior of light in the photonic crystal. From these results, we present the design of a band pass filter of 1.55 μ*m* wavelength. There are several possible designs of the band pass filter, and those designs have their own advantage separately. Some of the designs are advantage in the performance of a band pass filter, and some are easily to be fabricated. We can't say which the best one is, since we didn't do some experiment to verify our results. So, our group may try to do some experiment to verify our result. In our survey, the experiment method presented by Lehmann[1] could be suitable for our group.

The errors of the FDTD method mostly result from the transform of the Maxwell equations from differentiation to difference. We consider a differentiation of the electric field via space. In the basic calculus:

$$\frac{\Delta E}{\Delta x} \xrightarrow{\Delta x \to 0} \frac{dE}{dx} \tag{4.1}$$

Form Eq. (4.1), the differentiation is the from the limitation of Δx. The result of $\Delta E / \Delta x$ is closer to dE / dx as Δx is smaller. So, the precision is dependent on the size of Δx.

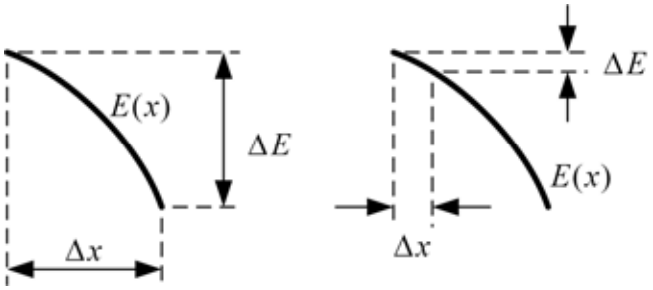

Fig. 4-1
The chart of the difference and differentiation.

Since we normalize the frequency and the wavenumber, we don't need to define the size of the grid (Δx). Therefore, the precision is dependent on the lattice constant. If we want to simulate the wave with a higher frequency, the lattice constant should be larger. Figure 4-1 shows our consideration.

We develop a FDTD program to calculate the properties of photonic crystals, and we also use it to design a band pass filter. But, we only discuss the one-dimensional photonic crystals and normal incident. In the future, our group will do the calculation of slight incident to find a omnidirectional band pass filter, and let the design more applicable for the optical device in the integral optical circuit.