

# INVESTIGATION OF EFFECTIVE PLASMA FREQUENCIES IN ONE-DIMENSIONAL PLASMA PHOTONIC CRYSTALS

C. J. Wu, 楊宗哲, C. C. Li, P. Y. Wu  
Ph.D. Program in Engineering Science  
Engineering  
yangtj@chu.edu.tw

## Abstract

In this work, a detailed investigation on the effective plasma frequency  $f_p^e$  for one-dimensional binary and ternary plasma-dielectric photonic crystals is made. We extract and then analyze the effective plasma frequency from the calculated photonic band structures at distinct conditions. In the binary photonic crystal, it is found that  $f_p^e$  in a photonic crystal is usually smaller than the plasma frequency  $f_p$  of a bulk plasma system.  $f_p^e$  will increase when the electron concentration in the plasma layer increases. It also increases as the thickness of the plasma layer increases, but decreases with the increase in the thickness of dielectric layer. In the ternary photonic crystal,  $f_p^e$  is shown to be decreased compared to that of in the binary one. Our results are compared with the analytical expression for  $f_p^e$  derived from the concept of effective medium. Fairly good consistence has been obtained for both results. Additionally, a discussion on the effect of loss on  $f_p^e$  is also given. The study is limited to the case of normal incidence.

Keyword : Effective plasma frequency, one-dimensional binary and ternary plasma-dielectric photonic crystals, normal incidence.