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# The slow light in the closed-packed face-centered cubic photonic crystal: characteristics and application design

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**Abstract** Using the plane wave expansion method, we calculated the energy band distribution of face-centered cubic (FCC) photonic crystals in the reciprocal lattice space. The influences of various dielectric constant materials on the properties of slow light are discussed. The results show that, in the close-packed hollow spherical FCC photonic crystal, the group velocity of light can be slow down to the velocity about $10^{-4}c$. And the slow light effect tends to occur more strongly in the hollow spherical structure in comparison with the dielectric spherical structure. The possible applications of the slow light effect in the 3D photonic crystal are proposed for solar cells and optical communication devices.

**Keywords** Slow light · Photonic crystal · Face-centered cubic (FCC)

## 1 Introduction

Slow light, which is a phenomenon whereby light travels with the obviously low group velocity, is a promising solution for buffering and time-domain processing of optical signals (Baba 2008). There were multiple pathways for slow light generation in early papers such as electromagnetically induced transparency (EIT) (Harris et al. 1990), stimulated Brillouin scattering (SBS) (Lin et al. 2000) and stimulated Raman scattering (SRS) (Podivilov et al. 2003) etc. However, the new requirements of slow light are expected for device and equipment fabrication. In the recent years, the control of group velocity from slow to superluminal was verified successively by considering the interaction between the electromagnetic wave

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