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Tunable band gaps in two-dimensional semiconductor-dielectric photonic crystals GERARDO MARTINEZ, MANVIR KUSHWAHA, Institute of Physics, University of Puebla, Mexico — This paper reports the multiple band gaps in the two-dimensional semiconductor-dielectric photonic crystals of several compositions: semiconductor (dielectric) thin cylinders in the dielectric (semiconductor) background. We consider both square lattice and hexagonal lattice arrangements and compute extensive band structures using a plane-wave method within the framework of an efficient standard eigenvalue problem for both E- and H-polarizations. The whole range of filling fractions has been explored to claim the existence of the lowest (the so-called acoustic band gap) and multiple higher-frequency band gaps within the first thirty to forty bands for various compositions. The completeness of the existing band gaps is substantiated by computing the band structures via detailed scanning of the principal symmetry directions covering periphery as well as the interior of the irreducible part of the first Brillouin zone and through the computation of the density of states. In general, the composition made up of doped semiconducting cylinders in the insulating background is found to be the optimum case for both geometries. Such semiconductor-dielectric photonic crystals which are shown to possess huge lowest band gaps below a threshold frequency (the plasma frequency) have an advantage over the dielectric photonic crystals in the emerging technology based on the photonic crystals.

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