OPTICAL PROPERTIES OF PERIODIC THREAD-LIKE DIFFRACTION GRATINGS AND PHOTONIC STRUCTURES

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A reflection (transmission) spectra of 2D rod like, threadlike and metal-dielectric gratings and photonic crystals (PC) are computed on the basis of modified matrix Riccati equation in the wavelength range of near IR spectrum up to millimeter wavelength region. It is show that (1) PCs composed of Si rods (square lattice of a period 20 mcm and 10 mcm in rods diameter) have an opaque band around 100 mcm in their transmission spectra. A metallization of Si rods with Ag layer (0.1 mcm thickness) allow PCs function as an efficient mirror (reflection of 99%) for TE waves with wavelength greater than 50 mcm. (2) PCs composed of Si rods (period 3 mcm and 1 mcm in rods diameter) have two opaque bands 4.5 – 5.5 and 7 – 9 mcm in their transmission spectra. A transmission spike (6 mcm) is appeared in the main opaque band due to the absence of one rods layer. Both an amplitude and spectral width of the spike depends on the total amount of rod layers in the PC; (3) four Si rod layers (1 mcm diameter, 3 mcm period) covered by 0.1 or 0.2 mcm Ag shell functions as an efficient mirror (reflection of 99%) for TE polarized wave with the wavelength greater than 6.5 and 5.5 mcm, respectively; (4) PCs composed of Al_2O_3 or SiO_2 rods have in their transmission spectra a PBG in the middle IR or millimeter regions providing that rods radii are equal to 10 mcm or 1 mm, respectively; (5) PC of fused silica threads may function as an efficient mirror (reflection of 99%) in the near THz region (25 – 30 mcm, TE polarized wave); (6) single layer of Si threads (0.8947 mcm diameter, 1.49 mcm period) may functions as narrow bandwidth spectral filter with broad angular tolerance around 1.55 mcm (see fig. 1).

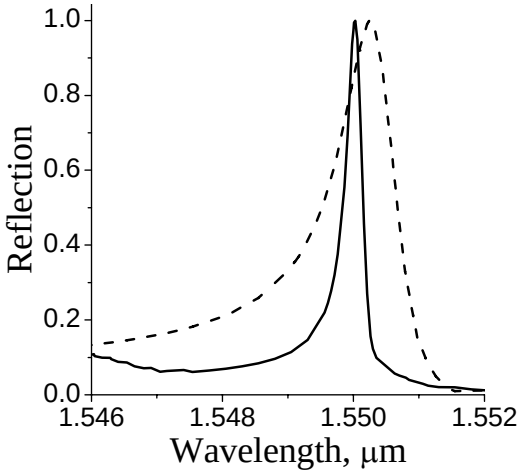

Fig. 1. Calculated reflection efficiency from a single layer of Si threads with 0.8947 mcm in diameter and period equal to 1.49 (solid line) and 1.45 mcm (dashed line)