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Realization of omni-directional 1-D photonic crystals

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One-dimensional (1-D) photonic crystals (PCs) turn out to have omni-directional photonic bandgaps (omni-PBGs) when well designed. Thus, researches on the 1-D PCs have been hot topics. In order to make the PCs controllable and versatile, the application of magnetic media as the components of PCs is a way of challenge, since the constituent electromagnetic parameters such as permittivity and permeability can be tuned by external field. This work is conserdering the optical properties of not only 1-D PCs consisting of dielectric Ti_2O_3 and Al_2O_3 but also 1-D magnetic PCs of these dielectric oxides and Bi:YIG thin films on a glass substrate. The reflectance and the transmittance spectra in the visible and the near infrared range have been investigated using transfer-matrix method. In the 1-D PCs based on oxide multilayers with quarter-wavelength optical thickness, the omni-PBG is not found at designed wavelength of 720 nm, since the effect of Brewster angle always exists in this system. However, a narrow omni-PBG is obtained away from the designed wavelength. A magnetic Bi:YIG layer with half-wavelength optical thickness is inserted into oxide multilayers, and a defect mode is observed at the designed wavelength and at the normal incidence. More defect modes can be obtained by incorporating more magnetic defect layers regularly into this structure. The off-diagonal components of dielectric tensor leads to a considerable amount of polarized light, perpendicular to the polarization direction of linearly-polarized incident light, which is not observed in the 1-D PCs without magnetic layers.