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Abstract - Experimental investigation results for the magnetic circular dichroism spectrum (MCD) of a photonic crystal (PC) are presented. We found that in the vicinity of the transmission peak within the photonic bandgap and also near the bandgap edges, the circular dichroism is measurable even in the absence of any applied magnetic field. The application of magnetic field leads to generating an additional MCD signal measurable at the wavelengths near the "defect mode" transmittance line.

A 1-D photonic crystal of structure $(HL)_5(LH)_5$ (H = ZnS, L = SiO_2 layers with the thicknesses of $\lambda/(4n)$, design wavelength 630 nm, the substrate was glass) was fabricated using RF magnetron sputtering. The transmittance of this PC in the visible-near IR spectral region is shown in Fig. 1. The dashed line shows the theoretical calculation for the transmission spectrum and the solid line shows the measured transmittance of our sample.

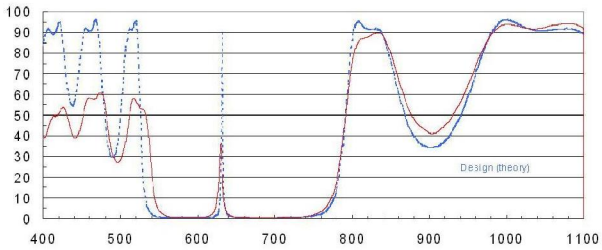

Figure 1. The transmittance spectra of a 1-D photonic crystal $(HL)_5(LH)_5$ (H/L=ZnS/SiO2). Y-axis is transmittance, the X-axis is wavelength in nm.

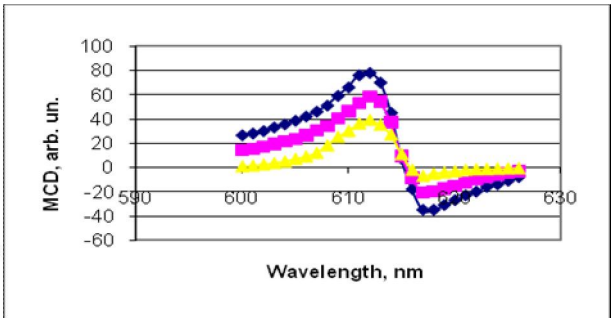

Figure 2. Spectral dependencies of the stress-induced CD (- -) and MCD (-◊-), (-Δ-) for the opposite directions of the applied magnetic field.

The circular dichroism (CD) measurement in the region between 360 – 850 nm revealed some peculiarities correlated with the regions near the bandgap edges and the defect-mode transmission line. Experimental results for the MCD spectrum of this photonic crystal are presented. We found (Fig. 2) that in the vicinity of the defect mode and also near the bandgap edges, CD is observed even in the absence of any applied magnetic field. The application of magnetic field provides an additional MCD signal related to the same transmittance line, in accordance with the theory prediction [1]. The strongest MCD signal was measured near the defect-mode transmittance line in the middle of photonic bandgap.

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1. Steel M. J., Levy M., and Osgood R. M., "Photonic bandgaps with defects and enhancement of Faraday rotation," *J. Lightwave Techn.*, Vol. 18, No. 9, 1297–1308, 2000.