A dielectric multilayer including azobenzene-polymer liquid crystal with non-quarter-wave stacks has been studied. The azobenzene-polymer liquid crystal has a photoinduced reversible refractive index based on photoisomerization. By using the reversible refractive-index change, the reflectance of the multilayer including azobenzene-polymer can be controlled. In this system, the azobenzene molecules change their conformation as a result of a cis-trans transition when they are irradiated with ultraviolet (UV) light. Unfortunately, in a thick multilayer, UV light does not reach the bottom part of the multilayer because UV light is mainly absorbed at its top surface. To solve this problem, the thickness ratio of the multilayer has been studied.

Figure 1 shows a schematic view of a dielectric multilayer consisting of azobenzene polymer liquid crystals, poly(vinyl alcohol) (PVA), and poly(methyl methacrylate) (PMMA). As mentioned above, the optical thickness of the layers are not quarter wavelength. The films were prepared on a glass substrate by alternate spin coating of the polymer solutions. Their reflection characteristics are unique because the films show multiwavelength reflections. Figure 2 shows the measured and calculated reflection spectra of the multi-layered film with non-quarter-wave stacks. We found that multiwavelength reflections appear by stacking thin azobenzene layers and thick other layers. This is because that the asymmetric periodic structure consists of many frequency components.

References: