

Analysis of the Spectral Transmittance of Christiansen Filters

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Abstract

Christiansen filters have been fabricated using powder of the optical glass K5 and methyl benzoate as immersion liquid. The matching of the refractive indices resulted in a pass-band maximum at 462 nm for 27.1°C. The spectral transmittance of these filters has been investigated as a function of the average grain size \underline{d} of the glass powder and as a function of the thickness z of the filters. The extinction for constant aperture of the light beam is proportional to z and inversely proportional to \underline{d} . The extinction increases less than proportional to the difference of the refractive indices $|\Delta n|$ of the glass powder and the liquid. In the literature we could not find a theory for the transmittance curve of Christiansen filters describing all of our experimental observations correctly. Therefore, we analyzed and evaluated our experimental results considering scattering, reflection, refraction, and diffraction. From the experimental data we must conclude that deflection by refraction is the dominating effect with minor contributions of the other loss mechanisms. On this basis we developed a simple approximate formula for the spectral transmittance of Christiansen filters, which is in convincing agreement with the experimental observations.