Glastechn. Ber. Glass Sci. Technol. **71** (1998), 319-326

Spectral transmittance of Christiansen filters: Experimental observations

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Abstract
Powder of the optical glass K5 has been immersed into methyl benzoate as refractive index matching fluid to fabricate Christiansen filters. The internal spectral transmittance of these filters has been investigated in the visible spectral region as a function of the filter thickness, the mean diameter of the powder grains, and the difference between the refractive indices of the fluid and the K5 glass.
The minimum internal spectral extinction of the filter curve is proportional to the thickness of the filter. Furthermore, it scales inversely with the average diameter of the glass grains. Hence, one can deduce that the minimum spectral extinction is proportional to the total interface area between grains and immersion liquid. According to our experimental results we can conclude further that this extinction is mainly due to Rayleigh scattering.
The halfwidth of the spectral transmission passband decreases with increasing thickness of the filters and with decreasing average diameter of the grains.
The spectral extinction at wavelengths sufficiently far from its minimum increases sublinearly with the filter thickness and the inverse mean diameter of the grains. In the same spectral region, the extinction increases also sublinearly with the absolute difference between the refractive indices of the material of the grains and of the immersion liquid. Until now, a theory predicting all of these observations correctly seems to be still missing.