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SiO2-Si film-substrate reflection polarizers for different mercury spectral lines

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SiO_2–Si film–substrate reflection polarizers for different mercury spectral lines

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In this Letter, we present data on SiO_2-Si film–substrate reflection polarizers designed to operate at different mercury spectral lines. We carried out the design at different wave-

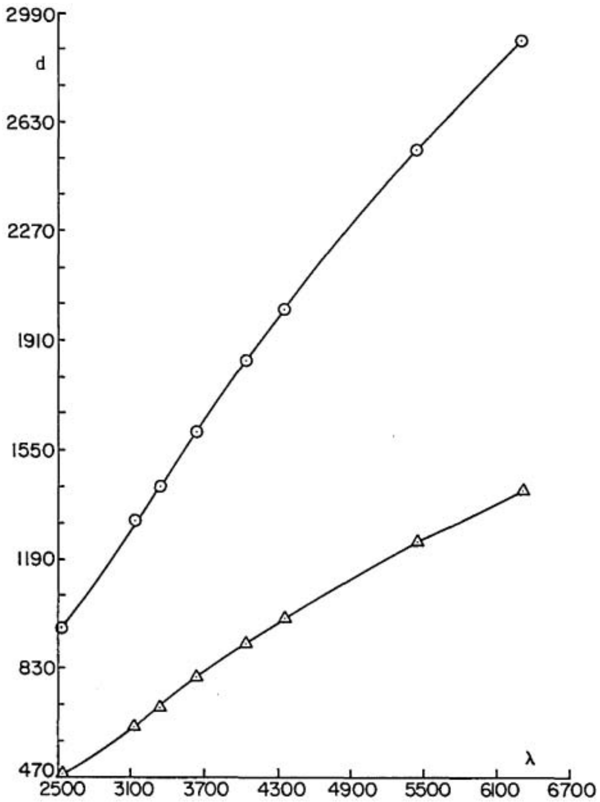

Fig. 1. The least polarizing film thickness d for SiO_2–Si p-(⊙) and s-(Δ) suppressing reflection polarizers as functions of the wavelength λ. λ and d are in angstroms.

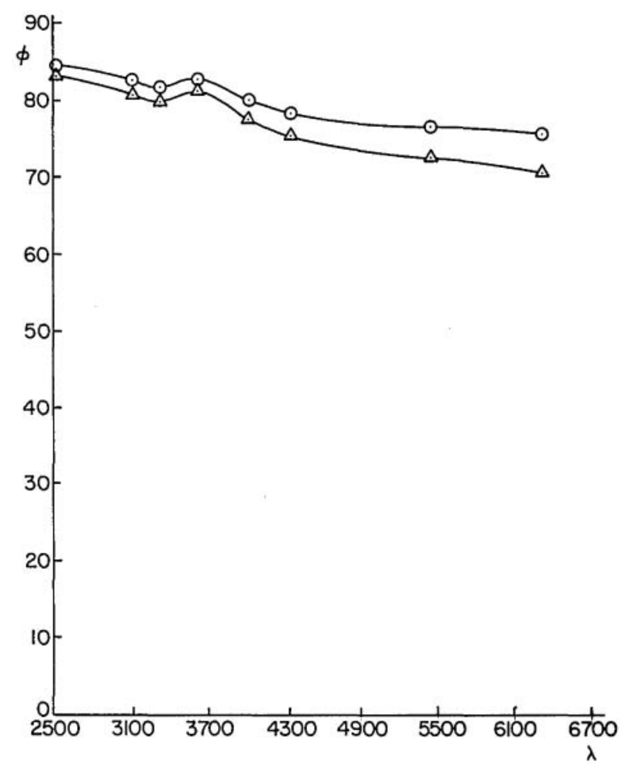

Fig. 2. The polarizing angle of incidence ϕ for SiO_2–Si p-(⊙) and s-(Δ) suppressing reflection polarizers as functions of the wavelength λ. ϕ is in degrees, and λ is in angstroms.

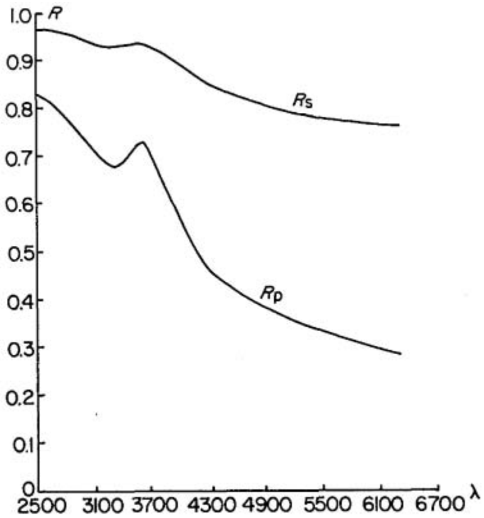

Fig. 3. The unextinguished reflectances R_s and R_p at the polarizing angle for SiO_2–Si p- and s-suppressing reflection polarizers, respectively, as functions of the wavelength λ (in angstroms).

lengths for the SiO_2–Si system. The procedure explained in Ref. 1 was used with $\rho = 0$ (for p-suppressing polarizers) and $\rho = \infty$ (for s-suppressing polarizers). The chosen wavelengths are the spectral lines of mercury: λ = 2537 Å, 3131 Å, 3341 Å, 3650 Å, 4046 Å, 4358 Å, and 5461 Å; and the He–Ne laser light of λ = 6328 Å. The optical properties of SiO_2 and Si are 1.50, 1.487, 1.48, 1.475, 1.47, 1.46, 1.45, and 1.46; (1.67, $-j$3.59), (4.90, $-j$3.63), (5.06, $-j$3.04), (6.63, $-j$2.74), (5.63, $-j$0.29), (4.83, $-j$0.116), (4.07, $-j$0.033), and (3.85, $-j$0.02), respectively.

The results are shown graphically in Figs. 1–3.[2] Figure 1 shows the dependence of the least polarizing film thickness on the wavelength for p- and s-suppressing polarizers. It is clear that the least polarizing film thickness increases monotonically with the wavelength for both kinds of polarizers. The polarizing angle for both kinds of polarizers does not show a similar monotonic behavior with the wavelength (Fig. 2). Figure 3 shows the unextinguished reflectance as a function of wavelength for the two kinds of polarizers. It is clear that better polarizers (with higher values of the unextinguished reflectance component) are obtainable at smaller wavelengths, where the extinction coefficient is larger.

A look at the ϕ–λ curve, Fig. 2, shows that the difference ($\phi_p - \phi_s$) decreases with the wavelength in certain regions of λ, so we expect the difference to approach zero by the appropriate choice of materials. By adding the appropriate multiple of the film-thickness period $D_{\phi_{p,s}}$[1] to the least polarizing film thickness $d_{p,s}$, we obtain a film thickness at which the film–substrate system acts as a reflection p-suppressing polarizer at ϕ_p and as a reflection s-suppressing polarizer at ϕ_s. It is interesting to note that the condition $\phi_p - \phi_s = 0^+$ leads to a nonreflecting film–substrate system.

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Polarization flipper for infrared laser beams: comment

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In a recent Letter,[1] Chraplyvy described a system of five mirrors capable of flipping the plane of polarization of laser beams by 90°. The purpose of this Letter is to point out that a similar property is possessed by the prism described by Klein[2] for use in X–Y scanning systems. This was brought to my attention by Treacy,[3] who also commented on the use of this property in the construction of a four-pass amplifier.[4] The system described in Ref. 2 employs two mirrors and a prism with three internally reflecting faces, while that in Ref. 4 employs a prism with four internally reflecting faces. Chraplyvy[5] comments on the disadvantages of prisms in the far ir, owing to transparency limitations of materials and reflection losses at entrance and exit faces. However, these problems are avoided by using mirrors, instead of prisms, arranged in the same orientations as the prism faces. What we then have are several alternative mirror systems for use as polarization flippers, the choice between them being governed by ease of construction and convenience of adjustment.

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