Spectropolarimetric interferometer based on single-mode *glass waveguides*

1. Single-mode potassium ion-exchanged (K^+ :PIE) glass waveguides that generally have a large birefringence due to the ***compressive stress*** (壓應力) induced in the ion-exchanged layers.

2. Potassium ion-exchanged (PIE) glass waveguides are inexpensive, low-loss, optically stable, mechanically and chemically robust, simple to fabricate, and compatible with single-mode fiber coupling.

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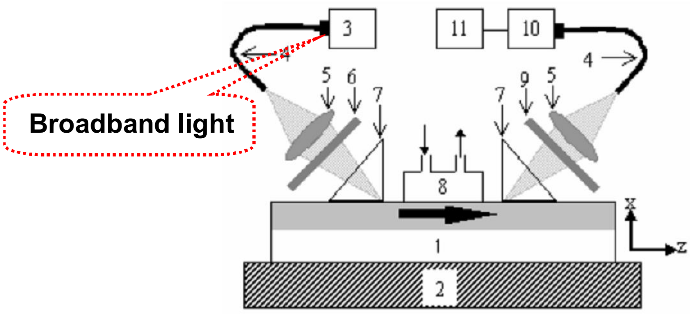
3. By using the ***spectropolarimetric interferometry*** (光譜極化干涉術), wavelength dependence of the ***modal birefringence*** (模態雙折) of single-mode PIE waveguides was accurately obtained in a broad bandwidth.

4. The modal birefringence decreases with increasing wavelength. The spectropolarimetric interferometer was demonstrated to be responsive to changes occurring within the penetration depth of the evanescent field.

Measurement setup: (1. single-mode PIE waveguide; 2. supporter; 3. xenon lamp; 4. quartz fiber; 5. lens; 6. polarizer; 7.prism; 8. chamber; 9 polarization analyzer; 10. CCD spectrometer; 11. computer).



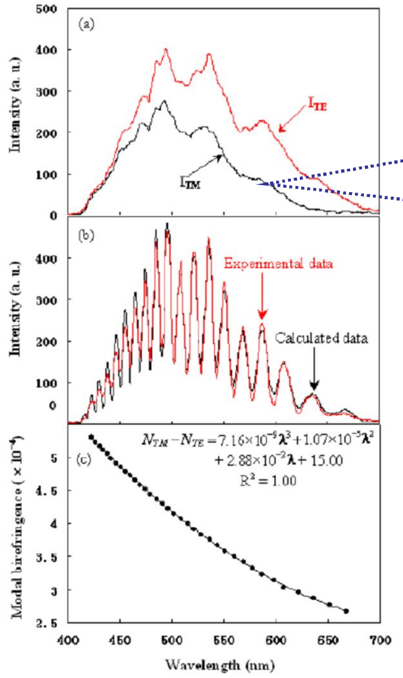
For interference between the TE and TM modes, the polarization angles of both the polarizer and analyzer were set to θ = 45^{o} with respect to the waveguide surface.

At each peak and dip positions the integral phase difference ($\Delta\varphi$) between the TE and TM modes is equal to $\boldsymbol{m}\pi$ (here ***m*** is the spectral order). $\Delta\varphi$ is related to the modal birefringence by Eq. (1), and the interference signal (***I***) can be written as Eq. (2).

$$\Delta\phi = \frac{2\pi}{\lambda} L(N_{TM} - N_{TE}) \quad (1)$$

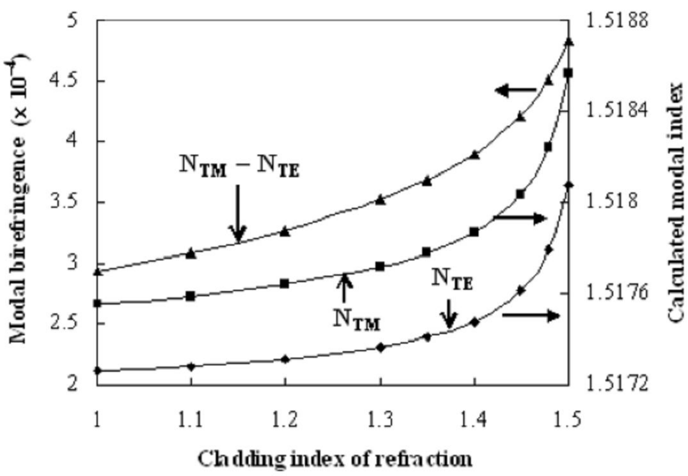
$$I = \frac{I_{TE}}{2} + \frac{I_{TM}}{2} + \gamma\sqrt{I_{TE} I_{TM}} \cos(\Delta\phi) \quad (2)$$

Where N_{TE} and N_{TM} are the modal indices of the TE and TM modes. The difference, $N_{TM} - N_{TE}$, is referred to as the modal birefringence. γ is a constant of less than 1, indicating the weakened interference due to slight splitting of the TE- and TM-polarized output components.

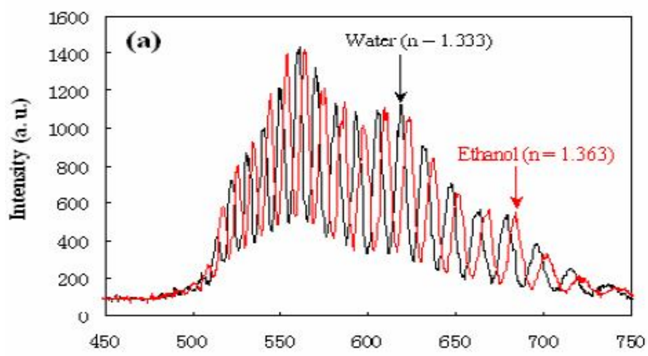


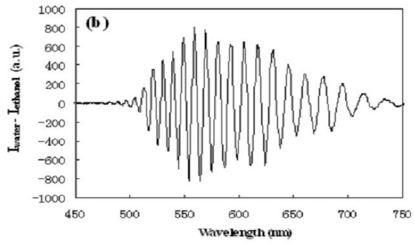
I_{TM} is more sensitivity to surface condition changes ***(with larger penetration depth)***

(a) Waveguide transmission spectra for the TE and TM polarizations
(b) Interference patterns measured and calculated
(c) the best-fit ***dispersion*** (色散) of the modal birefringence.



Modal indices and modal birefringences of the single-mode PIE waveguide calculated at λ = 633 nm as a function of refractive index of the cladding layer.





(a) Interference patterns measured with water and ethanol in the measuring Chamber.
(b) the difference between two patterns.