Etalon Effects in THz Film Measurements

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Introduction:

Etalon features in transmittance spectra of films arise due to the coherent superposition of waves caused by reflections multiple times at the inner film boundaries.

The fringe maxima occur at $i\lambda = 2nd\cos\varphi$ with i – being an integer, λ – the wavelength, d – the film thickness, φ – the angle of incidence in respect to the film normal and n – the refractive index of the film.

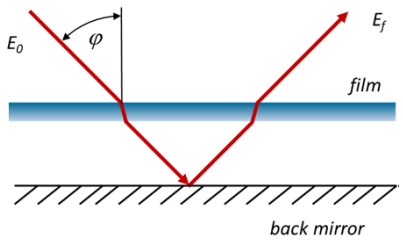
It is obvious that such features can hinder the interpretation of absorption bands when fringe amplitude and period are in the same range as the expected bands.

This paper discusses the suitability of two optical methods for the THz spectral range applied to Fourier Transform Spectroscopy.

Method 1:

The total transmittance reflection technique (TTR) is based on the compensation of fringes by introducing a backing mirror [1].

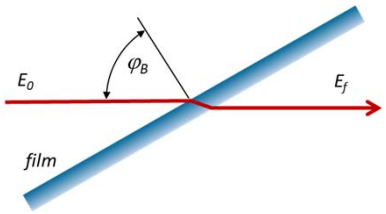
This method works for Fourier transform spectrometers, where the correlation of the two fields from the two interferometer arms is registered, however it cannot compensate for the reflection replicas in the pulse trail recorded with a time-domain spectrometer.



Method 2:

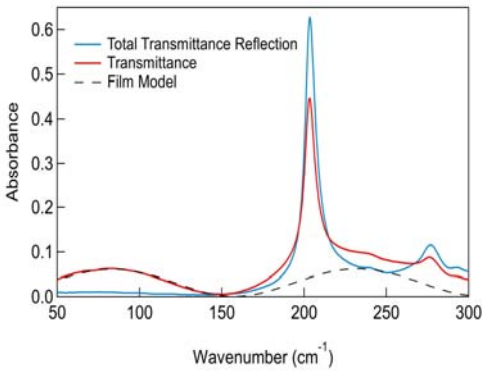
The Brewster's angle method [2] can be applied to both the time- and frequency-domain spectroscopy to eliminate fringes in transmittance spectra .

Here, the field oriented in the plane of incidence enters the film at the Brewster angle of the film material, where the reflectivity is almost zero and thus is the reflectivity at the inner boundaries of the film resulting in a fringe free transmittance spectrum.



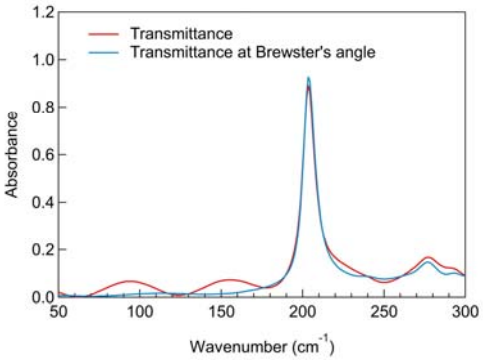
Results:

Both methods compared to normal incidence transmittance spectra.



Method 1:
25-μm PTFE film.

Method 2:
50-μm PTFE film.



References:

[1] R. F. Edgar and B. J. Stay, "Techniques for suppressing optical interference errors in infrared film thickness gauging," in *Proc. SPIE 0590, Infrared Technology and Applications*, 1985, vol. 0590, pp. 316–321.

[2] N. J. Harrick, "Transmission Spectra without Interference Fringes," *Appl. Spectrosc.*, vol. 31, no. 6, pp. 548–549, Nov. 1977.