Single tapered fiber tip for simultaneous measurements of thickness, refractive index and distance to a sample.

Moreno-Hernández C, Monzón-Hernández D, Hernández-Romano I, Villatoro J.

Opt Express. 2015 Aug 24;23(17):22141-8. doi: 10.1364/OE.23.022141.

Abstract.

We demonstrate the capability of an air cavity Fabry-Perot interferometer (FPI), built with a tapered lead-in fiber tip, to measure three parameters simultaneously, distance, group refractive index and thickness of transparent samples introduced in the cavity. Tapering the lead-in fiber enhances the light coupling back efficiency, therefore is possible to enlarge the air cavity without a significant deterioration of the fringe visibility. Fourier transformation, used to analyze the reflected optical spectrum of our FPI, simplify the calculus to determine the position, thickness and refractive index. Samples made of 7 different glasses; fused silica, BK7, BalF5, SF2, BaF51, SF15, and glass slides were used to test our FPI. Each sample was measured nine times and the results for position, thickness and refractive index showed differences of ± 0.7%, ± 0.1%, and ± 0.16% respectively. The evolution of thickness and refractive index of a block of polydimethylsiloxane (PDMS) elastomer due to temperature changes in the range of 25°C to 90°C were also measured. The coefficients of the thermal expansion and thermo-optic estimated were $\alpha = 4.71 \times 10(-4)/°C$ and $dn/dT = -4.66 \times 10(-4)$ RIU/°C, respectively.