Quantitative Optical Coherence Tomography for Characterization of Microscopic Structures with Varying Refractive Index

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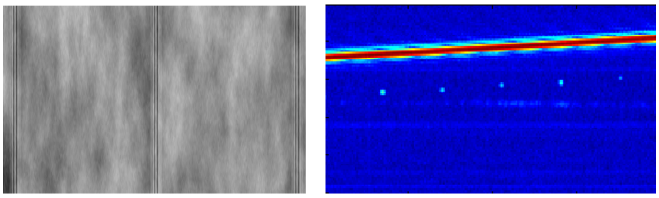
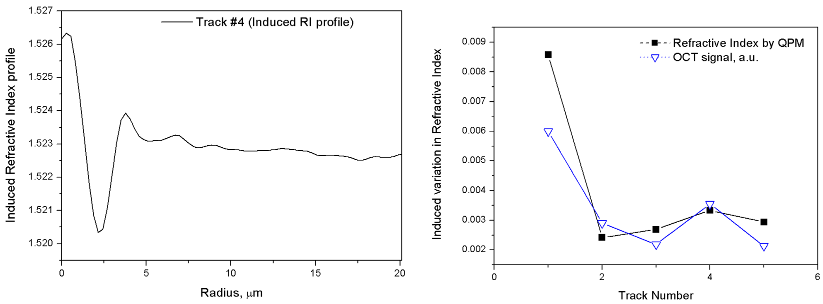
Optical Coherence Tomography (OCT) is non-invasive imaging modality, based on low-coherence interferometer. Since its first demonstration by Hung et. al. in [1], It has advanced further and become a significant imaging modality in medical and other fields. It can be divided into two types: Time Domain and Fourier Domains OCT systems. As it is becoming widely used, calibration and cross calibration of the OCT systems has become an important issue.

In this paper we have done back to back comparison of quantitive phase and refractive index from a microscopic image of waveguide previously obtained by Allsop et al in [2]. Figure1(a) shows microscopic image of the first 3 waveguides from the sample. Tomlins et al in [3] have demonstrated use of femstosecond fabricated artefacts as OCT calibration samples. Here we present the use of femtosecond waveguides, inscribed with optimized parameters, to test and calibrate the sensitivity of the OCT systems.



(a) (b)

Figure 1: Microscopic image of the sample(a), OCT image of the sample(b)



(a) (b)

Figure 2: Refractive index profile reconstructed using QPM method (a), Comparison of maximum variation of refrative index with OCT signal for different image of the sample(b)

In this paper, data is acquired using an OCT system (EX1301, Michelson Diagnostics, UK), where the swept source OCT system operates with a center wavelength of 1305nm. Axial and transverse resolution of the OCT system are usually defined in terms of coherence length of the light source and by Rayleigh criterion respectively. Axial and traverse resolution of the used OCT system are 8.4 ± 0.2 and 10.9 ± 0.2 μm respectively.

The OCT images are compared with the profiles of refractive index for femtosecond inscribed waveguides in borosilicate glass which were obtained by means of QPM method as described in [2]. The results of such comparison are presented in Fig. 2. An integrated OCT signal is compared with maximum variation of refractive index obtained with QMP method. The results prove OCT method as capable quantitative characterization technique.

References

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