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In vivo photothermal optical coherence tomography for non-invasive endogenous absorption agent imaging

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1. Introduction

Optical coherence tomography (OCT) has been proven in the last two decades its clinical value by providing non-invasive in vivo biopsy of the biological samples. In addition to structural information given by the backscattered intensity, the optical absorption will also provide another powerful contrast. Optical absorbers in biological tissues exhibits important role such as hemoglobin and melanin.

Photothermal OCT has been emerged to contrast the local displacement due to photothermal effect [1,2]. However, only demonstrations with exogenous agents are presented for cross-sectional imaging.

In this study, we developed photothermal OCT for in vivo absorption contrast imaging. The photothermal signal extraction algorithm for in vivo imaging was developed. The phantom imaging of this new method was done for proof of principle. In vivo human skin imaging was demonstrated.

2. Methods

System

A swept-source OCT system with a wavelength swept laser at 1310 nm is used (Fig. 1). Photocurrent from balanced photoreceiver is sampled by a high-speed digitizer. The k-clock output from the swept laser source is used for the sampling of the digitizer. The trigger is generated from the FBG.

At the sample arm, the OCT probe beam and an excitation laser are combined by a dielectric mirror. The fiber-coupled laser diode of 406 nm wavelength is used for excitation. The current injected to the laser modulated and the peak output power is set about 5 mW.

Photothermal imaging

The excitation laser is modulated by turn on and off for each imaging location. At each location several axial scans are acquired. The phase derivatives of OCT signal along time and depth are then averaged. Because of the modulation, the phase derivative is modulated too. Spatial frequency filtering applied to extract and discriminate other phase modulations.

3. Results

The human skin at inside of the forearm has been scanned by developed photothermal OCT. The images are shown in Fig. 2.

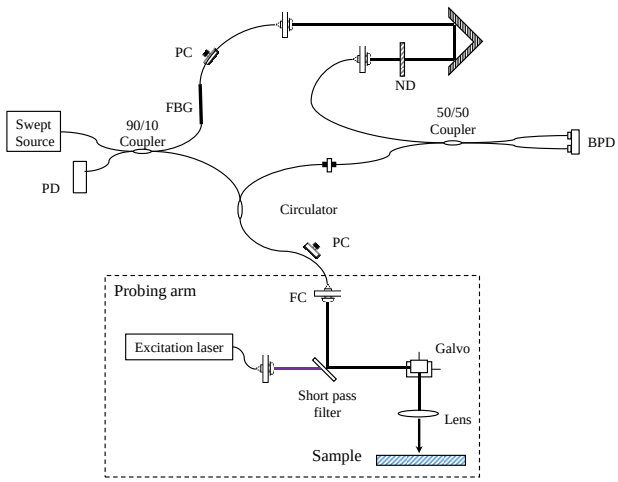

Fig. 1 The schematic diagram of photothermal OCT.

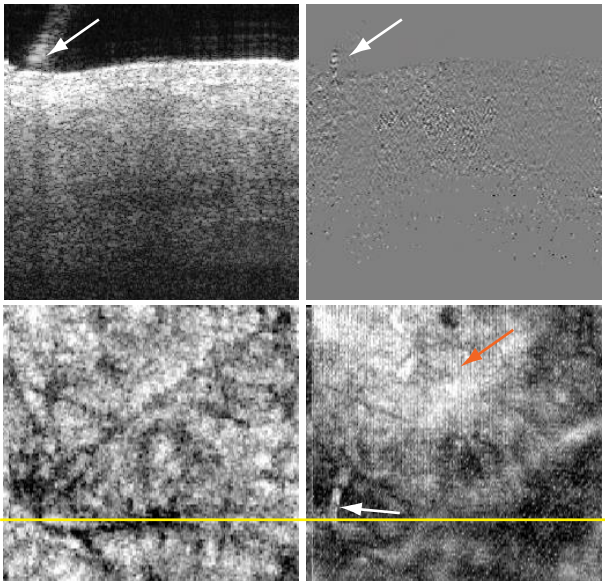

Fig. 2 Photothermal OCT images of human skin. (Left panes) OCT cross section (top) and projection (bottom) show the structure of the human skin. (Right panes) Photothermal OCT cross section (top) and projection (bottom) show the distribution of absorption tissues. High photothermal signals are appeared at a hair (white arrows) and a mole (orange arrow).

4. Conclusions

In vivo photothermal OCT imaging will provide additional contrast of biological tissue for OCT.

References

[1] D. C. Adler, Opt. Express **16** (2008) 4376.
[2] G. Guan, J. Biomed. Opt. **16** (2011) 126003.