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In vivo multiphoton microscopy and multiphoton absorption based laser therapy

We have developed a platform multimodality microscope that integrated reflectance confocal microscopy (RCM) imaging and multiphoton microscopy (MPM) imaging for in vivo tissue analysis. In our system MPM further includes two imaging modalities: two-photon excitation fluorescence (TPF) imaging and second harmonic generation (SHG) imaging. RCM, TPF, and SHG images are acquired simultaneously in real-time and co-registered. Different modalities in the system provide complementary information. For example, when applied in non-invasive skin analysis, RCM visualizes cell boundary and intercellular structures, TPF visualizes cell cytoplasm and cell nucleus, while dermal collagen and elastin are well visualized by SHG and TPF respectively. Application examples will be presented to demonstrate the powerful capability of this microscopy system for skin diagnosis and analysis. Based on the fact that multiphoton absorption occurs only at the focal point of a tightly focused femtosecond laser beam, we realized multiphoton absorption based photothermolysis in skin tissue utilized the above microscope system with high illumination power. This multiphoton photothermolysis leads to highly spatially selective tissue damage with a precision of a few microns in size. Tissues in a micron size volume are damaged while the surrounding tissues are unaffected. An application example on closing single blood vessels in a mouse ear model will be presented. This precision therapy modality has great potential for skin treatment.

Keywords: In vivo skin microscopy imaging, reflectance confocal microscopy, multiphoton microscopy, multiphoton absorption, multiphoton photothermolysis, multiphoton laser therapy

Biography

Haishan Zeng is a distinguished scientist with BC Cancer and professor at University of British Columbia. Dr. Zeng's research focuses on biophotonics and its medical applications. His group has pioneered the multiphoton-absorption based laser therapy and is at leading position in endoscopy imaging and Raman spectroscopy for noninvasive early cancer detection. He has published 200 refereed papers and holds 30 granted patents. Several medical devices derived from these patents including fluorescence endoscopy (ONCO-LIFE™) and rapid Raman spectroscopy (Aura™) have passed regulatory approvals. The Aura™ device was awarded the Prism Award in 2013 by the International Society for Optics and Photonics.

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