

Multiphoton Microscopy and Tomography of Human Skin

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The novel femtosecond NIR (near infrared) laser based high resolution imaging system *DermaInspect* was used for non-invasive diagnostics of human skin. The system provides fluorescence and SHG images of high spatial submicron resolution (3D) and 250 ps temporal resolution (4D) based on time resolved single photon counting (TCSPC). Pigmented tissue biopsies from patients with nevi and melanoma have been investigated using the tunable 80 MHz femtosecond laser MaiTai with laser wavelengths in the range of 750 - 850 nm. The autofluorescence patterns of different intratissue cell types and structures were determined. The non-linear induced autofluorescence originates from naturally endogenous fluorophores and protein structures like NAD(P)H, flavins, elastin, collagen, porphyrins and melanin. In addition to autofluorescence, SHG (second harmonic generation) was used to detect dermal collagen structures. Interestingly, pigmented cells showed intense luminescence signals. Further characterization of tissue components was performed via 4D measurements of the fluorescence lifetime (x, y, z, τ). The novel multiphoton technique offers the possibility of a painless high resolution non invasive diagnostic method (optical biopsy), in particular for the early detection of skin cancer.