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Polarization shaped laser pulses for selective two-photon excitation of autofluorescent molecules

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In recent years multiphoton excitation of biological samples by using ultrashort laser pulses became an important imaging method. Fluorescent molecules were employed to distinguish between tissue structures, and a high contrast is required for microscopic imaging. Thereto, laser pulse shaping provides a powerful tool by tailoring the pulses such that two species may selectively be excited. In particular, shaping of laser pulses is applied to exploit intrapulse interference effects in multiphoton excitation. Physically relevant parameters like chirps and polarization states can be controlled which yields perspectives of utilizing all light properties.

In this contribution pulse shaping methods for improved multiphoton excited fluorescence contrast are applied on auto fluorescing biomolecules after transmitting a nanostructured kagome fibre. Antisymmetric phase functions are employed for contrast enhancement of auto fluorescing vitamins. Moreover, phase and polarization tailored pulses are generated to optimally excite one dye in one polarization direction and simultaneously the other dye in the other polarization direction. Polarization sensitive contrast is obtained for the coenzymes nicotinamide adenine dinucleotide (NADH) and Flavin adenine dinucleotide (FAD), which give a measure for metabolic activity. This could provide non-invasive diagnostic information about tumour genesis without exogenous markers.

Moreover, combined temporal and spatial pulse shaping for lateral and axial two-photon excited fluorescence is reported by utilizing a temporal pulse shaper and a subsequent spatial pulse shaper. In particular, a depth dependent excitation of different dyes is performed which leads to a high axially resolved fluorescence contrast. The introduced spatial and temporal shaping technique provides new perspectives for bio photonic imaging applications.

Biography

Albrecht Lindinger has earned his PhD on helium droplet spectroscopy in Gottingen in the group of Prof. Dr. J.-P. Toennies and took his postdoc term in Berkeley in the group of Prof. Dr. D. Neumark. He received his habilitation in the field of coherent control at the Freie Universität Berlin in the group of Prof. Dr. L. Wöste and is now a lecturer (PD) in the Institute of Experimental Physics at the Freie Universität Berlin. He has published 91 peer-reviewed papers in reputed journals. His main scientific interests are laser optics, coherent control, and bio photonics.

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