Latest advancements in femtosecond lasers for non-linear microscopy applications

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Rapid developments in the field of nonlinear imaging are a strong driving force for the continuous advancements in parameters and operability of the commercial femtosecond laser sources used for these applications.

The technique of multiphoton microscopy is behind a number of research studies, including deep damage-free structural and functional imaging of in-vivo biological tissues with high spatial resolution and interrogations of neural activities in the brain. Historically, based on 2-photon excitation regime, the technique mainly relied on Ti:Sapphire tunable femtosecond laser technology. The growing interest in imaging and interrogating wider areas and deeper layers, especially in the brain, resulted in the development and rapid growth of 3-photon deep imaging [1], 2-photon holographic imaging [2] and optogenetic stimulation techniques enabling all-optical investigation of neural activities [3]. These newer optical techniques require longer wavelengths (up to 1.7 μm) and/or much higher energy/pulse from the laser source than conventional 2-photon imaging.

In parallel to the widening choice of laser parameters, other laser improvements are increasing the level of optical integration within experiment which helps to streamline the laser usage in the laboratory environment. In this presentation we will review the latest femtosecond laser developments that have impact in the field of nonlinear microscopy.

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