

Latest Developments in Ultrafast Supercontinuum Fibre Lasers and Applications within Fluorescence Microscopy

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Over the past five years we have seen significant developments in turnkey picosecond and femtosecond fibre laser technology. Ultrafast fibre lasers are now available, delivering high powers and high spectral power densities within the UV, Visible and Near IR regions of the spectrum, with supercontinuum lasers offering all of these spectral components simultaneously within a single, diffraction limited beam.

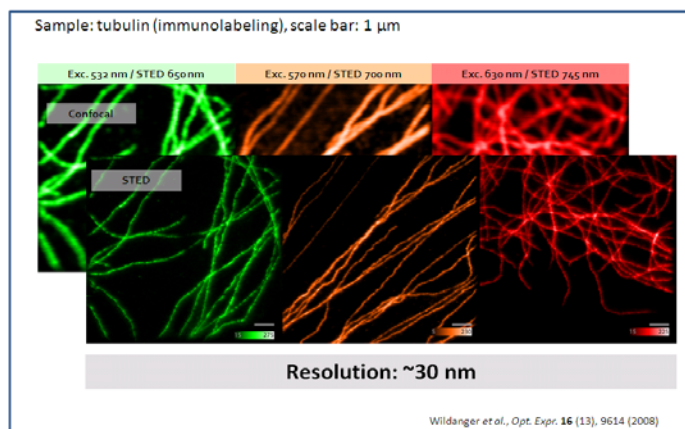


Figure 1 – STED Microscopy using a supercontinuum laser

Within fluorescence imaging, this technology is being applied across a wide range of techniques, including multi-photon microscopy [1], flow cytometry [2], confocal microscopy [3], FLIM [4] and more recently in super resolution (STED) microscopy [5].

In this paper and presentation, we provide an overview of the laser technology and concentrate on the latest specifications and applications within Confocal and STED Microscopy.

We report, for the first time, a turnkey UV-supercontinuum source applied within confocal microscopy and on a high repetition rate (80MHz) all-fibre laser for STED microscopy, offering a low-cost, high-performance alternative to Ti:sapphire-based systems.

- [1] Dombeck, D A, Sacconi, L, Blanchard-Desce, M and Webb, W W “Optical Recording of Fast Neuronal Membrane Potential Transients in Acute Mammalian Brain Slices by Second-Harmonic Generation Microscopy”, *JOURNAL OF NEUROPHYSIOLOGY*, 94: 3628–3636, (2005)
- [2] Telford, W G, Subach, F V and Verkhusha, V V “Supercontinuum white light lasers for flow cytometry”, *Cytometry Part A*, Volume 75A Issue 5, Pages 450 – 45 (2008)
- [3] Frank, JH; Elder, AD; Swartling, J; Venkitaraman, AR; Jeyasekharan, AD; Kaminski, CF, "A white light confocal microscope for spectrally resolved multidimensional imaging", *Jnl of Microscopy*, Oxford, 227:203-215(2007)
- [4] Dunsby, C, Lanigan, P M P, McGinty, J, Elson, D S, Requejo-Isidro, J, Munro, I, Galletly, N, McCann, F, Treanor, B, Önfelt, Davis, D M, Neil, M A A, and French, P M W “An electronically tunable ultrafast laser source applied to fluorescence imaging and fluorescence lifetime imaging microscopy”, *JOURNAL OF PHYSICS D: APPLIED PHYs* 37 3296-3303 (2004)
- [5] Wildanger, D, Rittweger, E, Kastrop, L, Hell, S, “STED microscopy with a supercontinuum laser source”, *Optics express*, V16, No13, 9614-9621, (2008).