Yb-fiber-based femtosecond source tunable between 760-1215 nm and 380-607 nm for two-photon/single-photon-confocal microscopy

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1. Introduction

We have demonstrated a compact and cost-effective femtosecond fiber source, aiming for replacing femtosecond Ti:sapphire lasers, *continuously tunable* between 760-1215 nm for two-photon fluorescence microscopy (TPFM), and its second harmonics tunable between 380-607 nm for confocal laser scanning microscopy (CLSM). The demonstrated light source has been integrated to a scanning microscope providing on-site imaging comparison from different modalities. A previous work demonstrated a fiber-based femtosecond source tunable from 825-1210 nm [1]; however, the limited pulse energy and spectral coverage hampered its application as a driving source for TPFM, especially the exclusion of the commonly-used two-photon excitation range below 800 nm. With a careful optimization of pulse duration and fiber selection, the spectral coverage of our femtosecond source is ideal for most of TPFM and CLSM applications, aiming for virtual optical biopsy and deep intravital observations such as neuronal networking [2] and metabolic micro-environments [3]. By using bandpass filters, we are able to select out-most spectral lobes enabled by self-phase modulation [1] with more-than-3nJ pulse energy enough for two-photon excitation at appropriate wavelengths, as well as frequency doubling from a Beta Barium Borate (BBO) crystal for CLSM images. Two-photon neuronal imaging with various fluorescence indicators have been demonstrated, examples shown in Figure 1. We will also discuss the on-site comparison of TPFM and CLSM images in different applications with our compact fiber source.

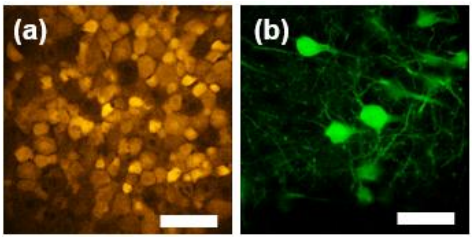

Figure 1. Two-photon image of (a) dorsal root ganglia (tdTomato) and (b) neurons in rat brain (Thy1-eGFP). Scale bar = 100 um.

2. Reference

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