

Stimulation gain and spontaneous loss based pump-probe microscopy

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Stimulated emission has become a versatile working principle for detecting dark fluorophores and fluorescence lifetime imaging [1-2]. It has also been widely used in optical microscopy for sub-diffraction imaging [3].

In this work, dual-channel pump-probe microscopy has been established that is based on stimulated gain and spontaneous loss. A pulsed diode laser, $\lambda_{pu} = 635$ nm, acts as the pump (excitation) and a mode-locked Ti-sapphire (76 MHz) laser, $\lambda_{pr} = 780$ nm, serves as the probe (simulation). The time delay (τ) between the pump and the probe pulses are precisely controlled by adjusting the length of the triggering cable. The stimulated gain and spontaneous loss signals can be extracted by modulating the pump and the probe beams accordingly.

In this way, the fluorescence lifetime and the 3D optical sectioning can be acquired in an optically coherent manner with reduced background. Note that compared with multiphoton excitation, pump-probe microscopy takes advantages of transitions between real states, which promise far greater cross sections. Such uniqueness would allow deep tissue imaging without the need of femtosecond lasers.

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