# MULTICOLOR STIMULATED RAMAN SCATTERING MICROSCOPY WITH A WIDELY TUNABLE PORTABLE LIGTH SOURCE

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**KEY WORDS:** Stimulated Raman scattering microscopy, tunable light source, coherent Raman scattering imaging.

We present high-speed multicolor stimulated Raman scattering imaging (SRS) enabled by an all-fiber light source.

Fiber-based light sources, offering an alignment-free operation combined with a compact footprint, represent promising tools to enable routine applications of coherent Raman imaging. However, a remaining issue of fiber lasers compared to free-space lasers is the presence of high-frequency intensity-noise, limiting the application to stimulated Raman scattering microscopy (SRS). By utilizing a narrow, high-fidelity bandpass filter in the pump laser of an all-fiber optical parametric oscillator (FOPO), we were able to reach a RIN of the Stokes output as low as -157 dBc. With this noise level, the Stokes output of the FOPO is shot-noise limited up to a detector current of 0.75 mA. Recently proposed fiber-based light sources exhibited comparable noise levels, e.g., -140 dBc [1], -147 dBc [2] or -165 dBc [3]. However, as all these systems made use of synchronized ytterbium-doped and erbium-doped fiber lasers, only vibrational resonances in the CH-stretch region were accessible due the limited gain bandwidth of the systems. In contrast, the presented light source is tunable in under 5 ms across the spectral range of 700 – 3530 $cm^{-1}$, covering all major Raman resonances. Therewith, the wavelength can be switched in a frame-by-frame manner for multicolor SRS with a theoretical limit of up to 100 frames/s, assuming equal time for tuning and acquisition. We present live SRS imaging at 8 frames/s - limited only by our non-resonant galvanometer scanner - differentiating deuterated DMSO and lipids.

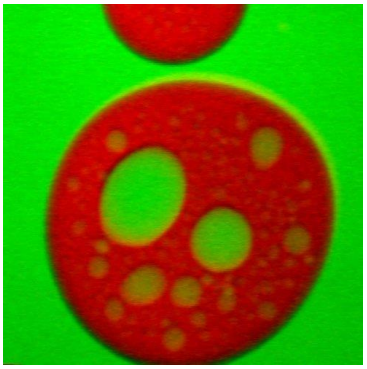

**Fig. 1:** Merged two-color SRS image of a colloidal mixture of dDMSO and olive oil obtained by tuning to the 2150 $cm^{-1}$vibration (symmetric CD, green) of deuterated DMSO and the 2850 $cm^{-1}$vibration (symmetric $CH_2$, red) of lipids. Acquired with a pixel dwell time of 10 µs.

**References**

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