TWO NEW APPROACHES TO BROADBAND STIMULATED RAMAN SCATTERING MICROSCOPY

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Stimulated Raman scattering (SRS) microscopy is a powerful technique for label-free identification of cells and tissues based on their intrinsic vibrational spectrum. Single-frequency SRS is now working very reliably with high acquisition speeds; however, its information content is not sufficient to distinguish the different components within complex heterogeneous systems. Here we present two broadband SRS microscopy setups combining broad spectral coverage (up to 500 cm^{-1}, covering the entire C-H stretching band) with high frequency resolution (≈ 15 cm^{-1}). Narrowband Stokes pulses at 1040 nm are synchronized with broadband pump pulses in the 715-870 nm range, generated by a tailor-made low-noise optical parametric oscillator at 80-MHz repetition rate. We employed the in-line balanced detection (IBD) approach [1] to suppress laser fluctuations and achieve close to shot-noise-limited sensitivity.

The first solution we propose comprises a hyperspectral SRS detection scheme in which a diffraction grating and a galvanometric mirror after the sample are employed to rapidly scan the Raman frequency using a balanced photodiode and a single-channel commercial lock-in amplifier with 1.8-μs integration time, see Fig. 1 [2]. The second solution involves a multiplex (parallel) detection scheme that employs a recently developed balanced low-noise multichannel lock-in amplifier with 10-μs integration time for collecting the spectrum with up to 32 channels in parallel. In both cases, we will present the performances in broadband SRS microscopy, illustrating their advantages and drawbacks.
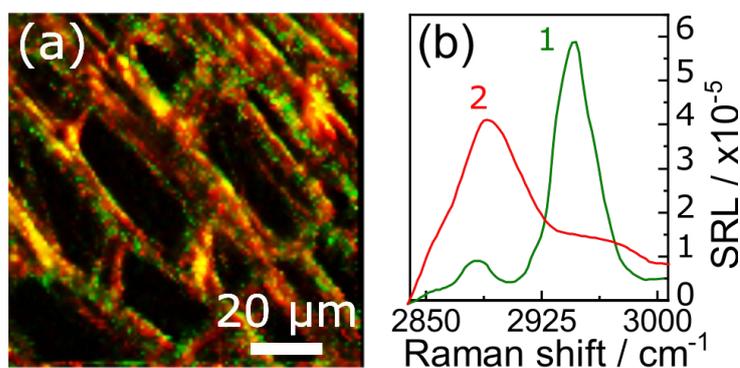

Figure 1: Chemical imaging of an *Elodea Canadensis* leaf. (a) Concentration distributions of the two main components extracted from multivariate curve resolution chemometric analysis; (b) corresponding spectra.

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