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Coherent Raman imaging for scientific and biomedical applications.

Abstract:

We are developing coherent Raman microscopes and endoscopes suitable to perform chemical imaging for scientific and biomedical applications.
We have developed a picosecond laser source that can that can address simultaneously two vibrational wavenumbers for ratio-metric imaging and background rejection. The two wavenumbers can be addressed anywhere across the entire vibrational spectrum (400cm^{-1} – 4000cm^{-1}). The laser source is coupled to a ready to use beam scanning microscope enabling SRS, CARS and multiphoton microscopy. We are also developing a flexible endoscopes imaging probe featuring a diameter of 1.3mm at its distal end. The endoscope can perform CARS, SHG and multiphoton imaging for in vivo applications.
We will exemplify the ability of the developed microscope and endoscope technologies in various fields including cell imaging, drug penetration in skin, pharmaceutical imaging, food imaging... By targeting the CH_2 and CH_3 chemical bonds, we also demonstrate instantaneous stimulated Raman histology on freshly excised biopsies and on living organoids. Finally, we show the suitability of the systems to perform metabolic imaging on bacteria and drosophila fed with deuterated glucose.
SRS/CARS/multiphoton microscopes and endoscopes enable molecular detection and imaging with exquisite sensitivity (shot noise limited) and ratio-metric availability. By targeting simultaneously two vibrational frequencies that can be tuned anywhere across the vibrational spectrum. The microscopes and endoscopes are suitable to perform video rate chemical imaging for a broad range of scientific and medical applications.

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Figure

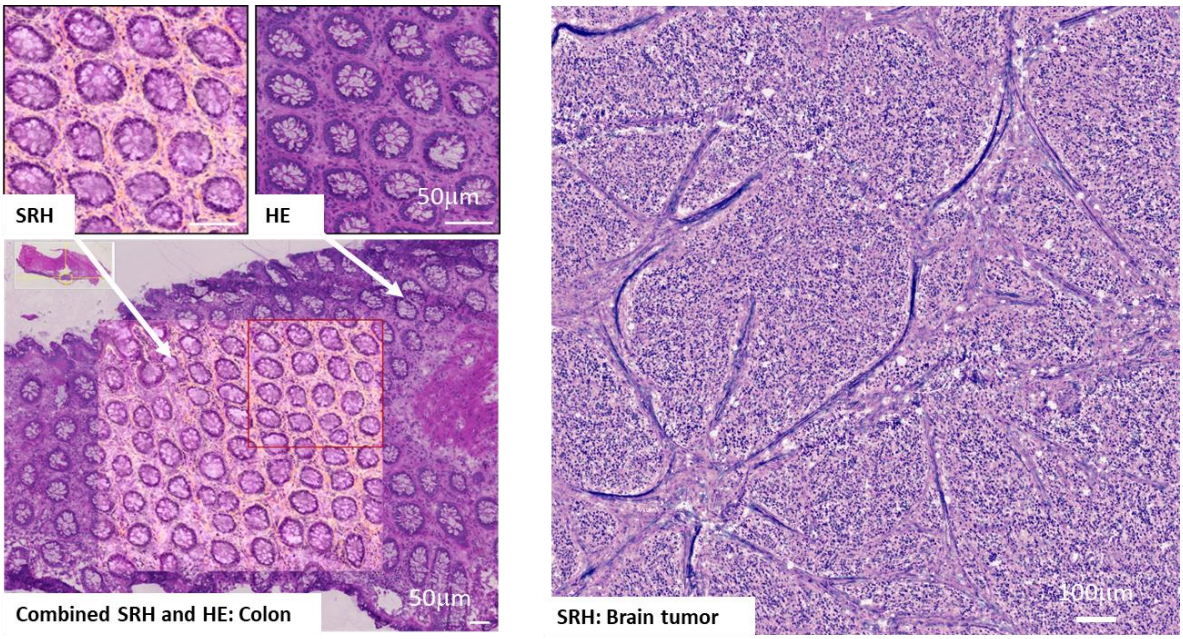

Figure 1: Right: Exemple of stimulated Raman histology (SRH) images as compared to standard hematoxylin and eosin images (HE). **Left:** SRH image of a brain tumor (1mm x 1mm, imaging time 2 minutes)