APPLICATION OF COHERENT ANTI-STOKES RAMAN SCATTERING IN BIOLOGY

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KEYWORDS: Coherent anti-Stokes Raman scattering, multiplex, CARS, Raman, vibrational spectroscopy, hemoglobin, oxygenation

ABSTRACT

Coherent Anti-Stokes Raman scattering (CARS) is the non-linear analogue of spontaneous Raman scattering. The advantages of CARS lie in the coherent and non-linear nature of the process, due to which the CARS signal is high (about 4 to 5 orders of magnitude larger than the linear Raman signal) and the signal is easily discriminated from background luminescence. Also, CARS offers the possibility of 3-D imaging thanks to its inherent optical sectioning capabilities. Multiplex CARS microscopy and spectroscopy provide chemical, physical and quantitative information on the studied sample. However, due to the coherent addition of both resonant and non-resonant contributions, the lineshape of CARS spectra is complicated. This is especially the case for biological samples which give rise to highly congested spectra. In order to extract information from our measured spectra, we apply a direct phase retrieval algorithm based on the maximum entropy method. This allows us to study biological samples without the need of *a priori* spectral information on the sample.
We have used multiplex CARS spectroscopy to quantitatively measure the oxygen saturation level of hemoglobin. Unlike other optically based techniques developed to determine blood oxygenation, CARS has, in principle, the capability to resolve the signal from individual vessels located in (highly scattering) tissue. Because the oxygenation state of the blood is a key determinate of physiological state, direct determination of the oxygenation of blood in vessels in live tissue would provide elusive information in studies concerning vascular dysfunction. The experimental results are discussed and future potential of the technique in biological applications is indicated.