Broadband stimulated Raman scattering for non-linear label-free microscopy of cells and tissues

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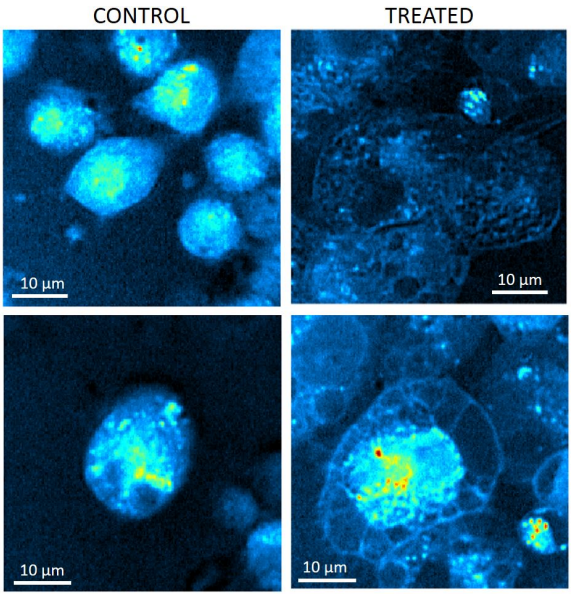

Fluorescence microscopy is a powerful investigation tool for life sciences. It can visualize morphological details in cells and tissues with sub-micrometer resolution and single-molecule sensitivity. However, fluorescent markers can perturb the investigated system and induce phototoxicity. This calls for intrinsic, label-free imaging methods such as Spontaneous Raman (SR) microscopy. SR measures the vibrational spectrum that characterizes every component of a biological specimen, reflecting its molecular structure and providing an endogenous and chemically specific "fingerprint". Its main drawback is the very low scattering cross section, making it difficult to probe diluted species and preventing real-time imaging of dynamical processes in living cells or tissues. These limitations can be overcome by the use of coherent Raman scattering (CRS) techniques. CRS is a nonlinear optical technique employing a sequence of ultrashort pulses to set up and detect a vibrational coherence within t he molecules in the laser focus, which enhances the Raman response, thus allowing high imaging speeds with 3D sectioning capability. In this talk, I will review the state of the art and recent advances of CRS microscopy, in both coherent anti-Stokes Raman scattering (CARS) and stimulated Raman scattering (SRS) modalities. In particular, I will show a few examples of their application in biology, for studying cells and tissues and for tumor identification.