Biophotonics Laboratory, 6F IFReC Building
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Research theme: Development of Label-free imaging modes

Applications: analysis of immune cell phenotypes, activation state, disease diagnosis and more.

Why Label-free?

Sub-cellular imaging is normally done by fluorescence imaging, which typically has:

+ Excellent specificity for known targets
+ Extensive history/validation
+ High resolution, 3d capability, etc
- Difficult for new or unknown targets in a cell.
- Difficult to resolve any changes which do not have robust fluorophores already developed

Label-free modes are based on endogenous or inherent contrast in the sample. We exploit chemical signature (Raman), morphological features (phase) or both to measure changes within or between immune cells.

We then create a system that can determine, for example, lymphocyte phenotype, macrophage activation characteristics, or other features of interest.

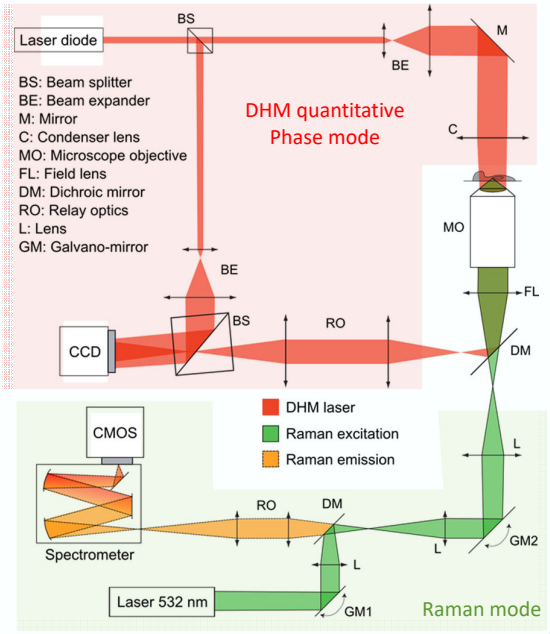
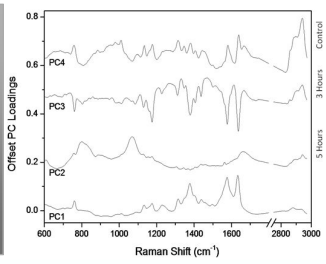


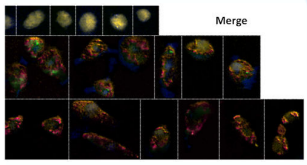
Figure 1: Simultaneous multimodal Phase-Raman setup

Example application: Label-free Raman imaging of malarial hemozoin uptake in macrophages: System optimization, measurement and analysis

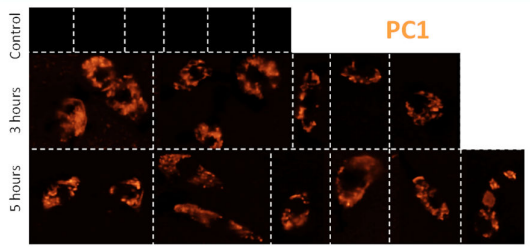
PCA analysis discriminates both positive and negative features:

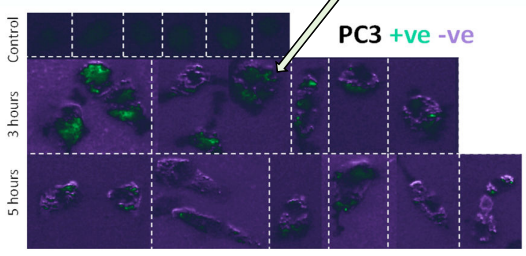
PC1 : Hemozoin (heme)
PC2 : Proteins (phosphate, amide, beta sheet)
PC3+ : Transient lipid response (CH_2 vibrations)
PC3- : Hemozoin probably associated with lipids (heme)
PC4+ : Lipid distribution (CH_2, C=C, C-C and CO2- vibrations)
PC4- : Shifted hemozoin spectra at pH 4-6 (heme)

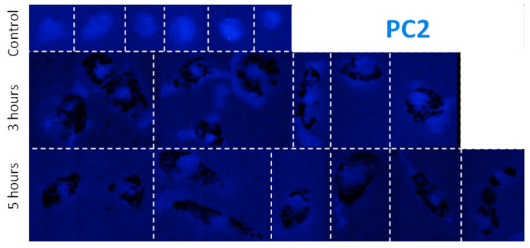


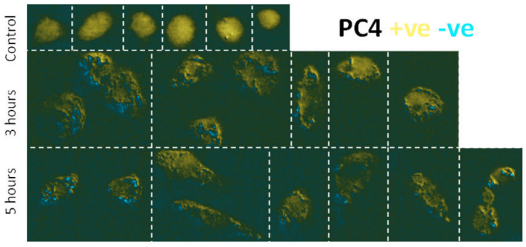


Green channel appears predominantly 3 hours after incubation









A. Hobro, N. Pavillon, K. Fujita, M. Ozkan, C. Coban and N. I. Smith, Analyst 140, pp. 2350-2359 (2015)