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Noninvasive, In-Vivo, Tissue Modulated Near Infrared Spectroscopy of Fingertips: Resonance Raman Spectrum of Human Hemoglobin

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TISSUE MODULATION

Tissue modulation refers to using external stimuli such as mechanical pressure and temperature to produce various spatiotemporal distributions of blood and conceivably other fluids in tissues. Having the capacity to execute tissue modulation1 allows forms of difference spectroscopy to be used to isolate spectroscopic signals from specific components of the tissues noninvasively and in vivo. In the case of human fingertips we can think of the tissues present in the probed volume as being static tissue, plasma and red blood cells (RBCs). Static tissues deform under mechanical pressure based tissue modulation and the only possible fluid motions2 involve plasma and RBCs. Figure 1 shows the difference spectrum produced, negative modulated fluorescence and positive modulated Raman, when simultaneously a small amount of RBCs move into and some plasma is move out of the probed volume. We present spectra for all limiting forms of tissue modulation and show prototypical spectra that include fluorescence Rayleigh/Mie and Raman scattering.

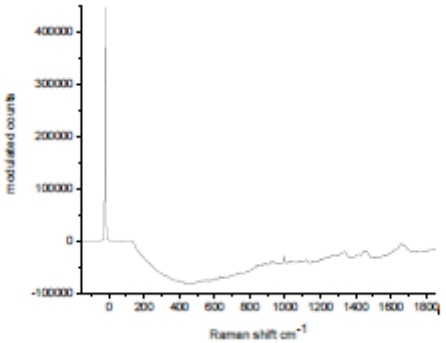
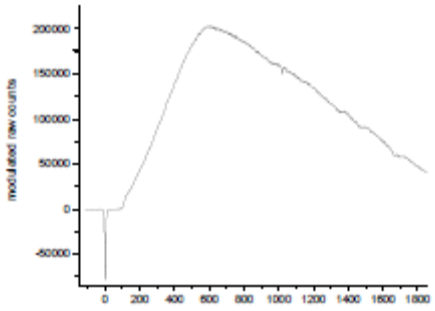
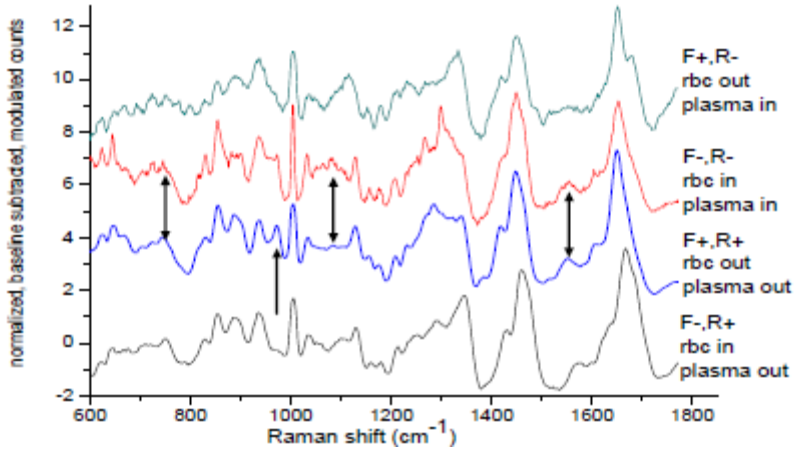


Figure 1. Example of archetypical tissue modulated spectrum due to movement of relatively small volume of RBCs into probed volume and some plasma out of probed volume.

Figure 2 shows a positive modulated fluorescence component with a negative modulated Raman component. Figure 3 shows baseline corrected Raman spectra of 4 types with resonance Raman features indicated.



example of archetypical tissue modulated spectrum due to movement of small to average volume of RBCs out of observation region and some plasma into region



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