

Time Resolved Nanoparticle Optical and Hyperspectral Microscopy

The ability to optically observe and spectrally measure external perturbations of nanoparticles in real time from both a spatial and temporal perspective is critical in a wide range of nanomaterials research initiatives. To meet this need, CytoViva has added single nanoparticle time resolved hyperspectral imaging to its Enhanced Darkfield Hyperspectral Microscope System (EDHM).

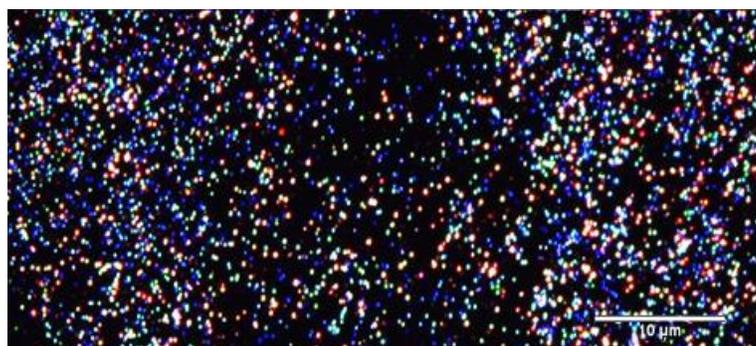


Figure 1: 30nm AgNPs Aggregating in DI Water

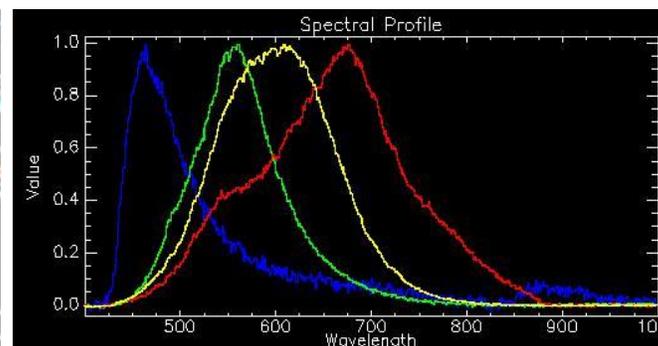


Figure 2: Spectral Measurements of Aggregating AgNPs in DI Water



Figure 3: 30nm AgNPs Dispersed in an Ionic Solution

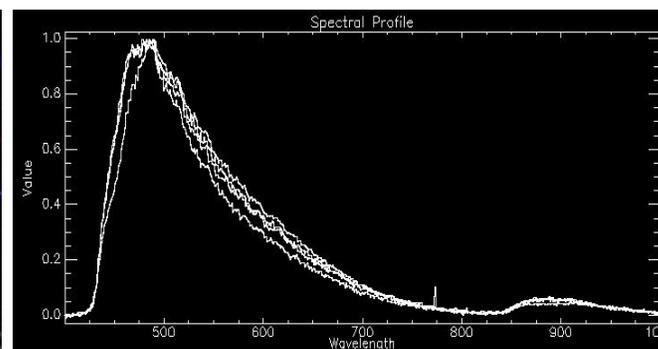


Figure 4: Spectral Measurements of Dispersed AgNPs in an Ionic Solution

CytoViva's EDHM optics enable real time observation of nanoparticles as they are modified with chemical, magnetic field or other stimuli that change the appearance of the nanoparticles. These changes can be captured via video and observed in the microscope eyepiece. Figures 1-4 above illustrate how changes in the environment of 30nm AgNPs are optically observed and spectrally measured. In this example, nanoparticles exposed to a DI water environment versus an ionic solution are shown. These images demonstrate how the ionic solution creates a very homogenous distribution of the nanoparticles across the sample versus the more aggregated nanoparticles in DI water. This is not only observed visually with almost all nanoparticles in the ionic solution appearing blue, but also measured spectrally among individual nanoparticles across the sample. These colors are due to the plasmon resonance of the nanoparticles.

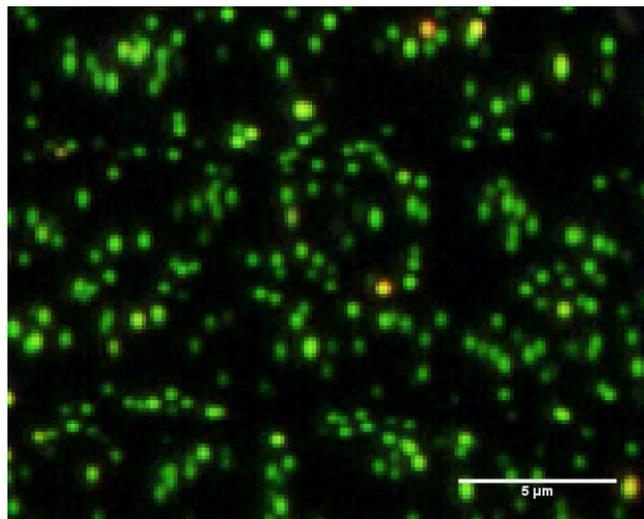


Figure 5: Enhanced Darkfield Hyperspectral Image of 50nm AuNPs at 100x Plus 4x Digital Zoom

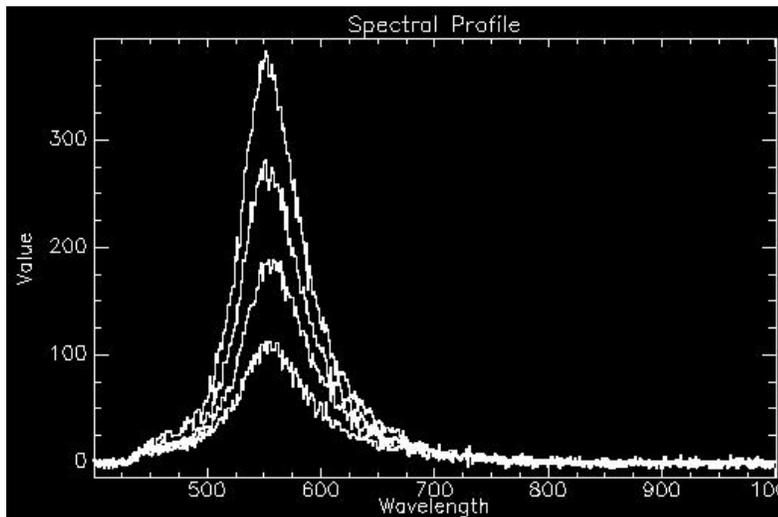


Figure 6: Time Resolved Spectral Changes of a Single AuNP Measured at 200 Milliseconds with Reduced Output of the Source Illumination Decreasing the Nanoparticle Peak Amplitude

With the addition of time resolved hyperspectral imaging, it is also possible to measure real time temporal changes in the optical spectral response of nanoparticles as they are modified by external stimuli. In figures 5 and 6, the spectral response of 50nm AuNPs adhered to a glass slide are modified by modulating the intensity of the halogen source illumination creating the optical image. A decrease in the output of the light source resulted in a decrease in the peak amplitude of a single nanoparticle in the sample, where the spectral response is measured at 200 millisecond increments. This single nanoparticle spectrum change was representative of the changes across all nanoparticles in the field of view.

Please contact us at info@cytoviva.com to learn more about CytoViva's EDHM and its ability to record both spatial and temporal changes in nanoparticles in the presence of external stimuli. We would be pleased to discuss your research and arrange for test imaging of your samples if appropriate.