New Nanoscale SWIR Hyperspectral Microscopy

The CytoViva Hyperspectral Microscope System has extended spectral detection from the visible near infrared (VNIR) range of 400nm-1,000nm to now include spectral response measurements in the short wave infrared (SWIR) range from 900-1,700nm. This addition is in response to the development of many new nanomaterials with unique spectral characteristics in the SWIR area.

New nanomaterials are often designed with specific spectral properties to enable easy delineation of the nanomaterial from its target environment. In addition, many nanomaterials such as carbon nanotubes produce repeatable spectral characteristics in these wavelength ranges. Finally, detection at these wavelengths can also allow for unique surface measurements such as the ability to detect different coatings on silicon wafers.

Some nanomaterials reflect light in the SWIR spectral range based on rotational and vibrational movements. This motion can be tracked by the spectral response reflected off the surface of the nanomaterial. Figure 1 illustrates a hyperspectral image of multi-walled carbon nanotubes (MWCNTs) in solution. This was captured using the patented CytoViva enhanced darkfield microscope capability and SWIR hyperspectral imaging system. The green, red, and blue are the areas associated with the spectral responses illustrated in Figure 2. The spectral responses shown in Figure 2 are consistent with the very slight variation associated with the chemical structure of MWCNTs.

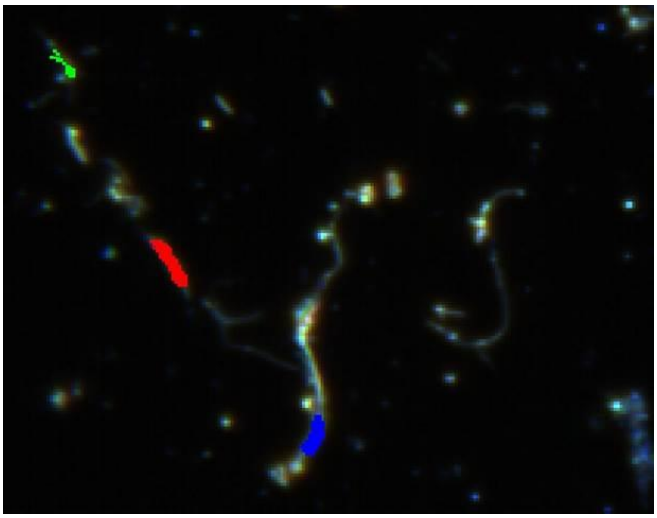

Figure 1: MWCNT in Solution

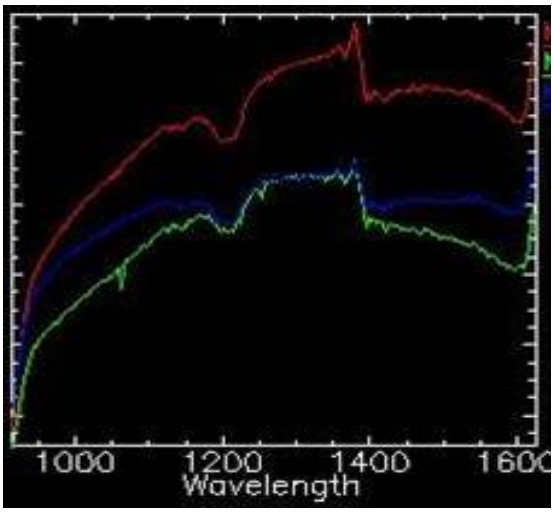

Figure 2: Spectral Response of MWCNT in Solution

Figure 3 illustrates a hyperspectral image of a standard silicon wafer taken with a reflected light microscopy method. Figure 4 shows the SWIR spectral responses of three components in the sample. The white curve shows the response of the white surface area, the red curve shows the response of the brown coating material and the green curve shows the response of the green coating material.

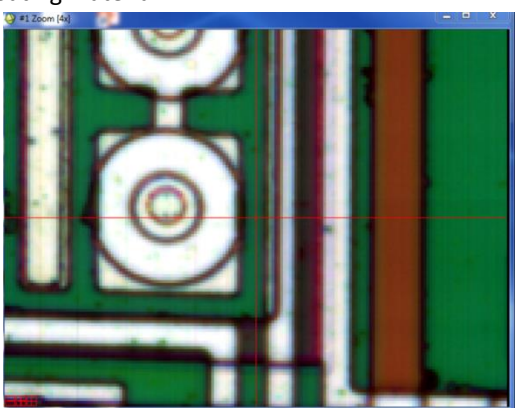

Figure 3: Standard Silicon Wafer

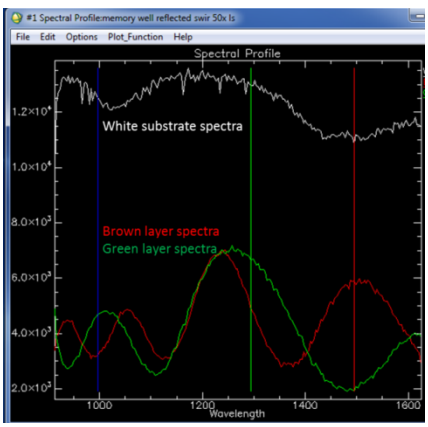

Figure 4: Spectral Response of Wafer Layers

This unique SWIR hyperspectral capability is possible by integrating a specialized InGaAs detector and SWIR spectrograph onto the CytoViva microscope system. To determine the best detector and light source combination, the photo response of the detector and emission of the light source needed to be optimized.

Figure 5 is a graph illustrating the InGaAs detector's photo response in the SWIR range. This detector and spectrograph combination is paired with an aluminum reflecting light source that excites from the visible through the SWIR ranges. Figure 6 is a graph comparing the spectral output of an aluminum reflector (magenta) to a dichroic reflector (teal). This graph shows the aluminum reflector to be a very efficient emitter in the SWIR ranges.

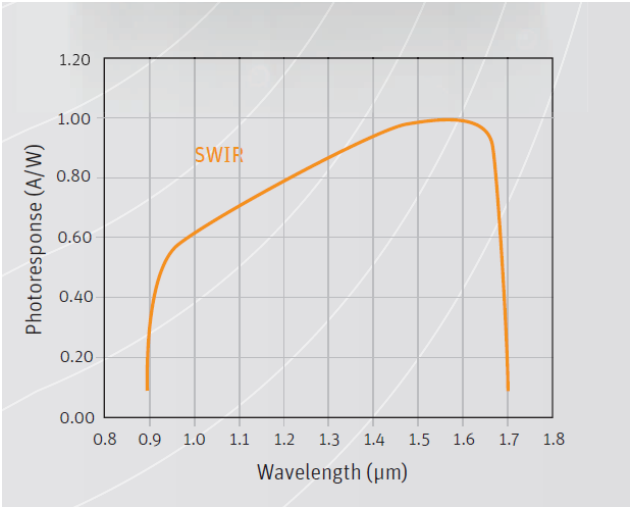

Figure 5: Photo Response of SWIR Detector

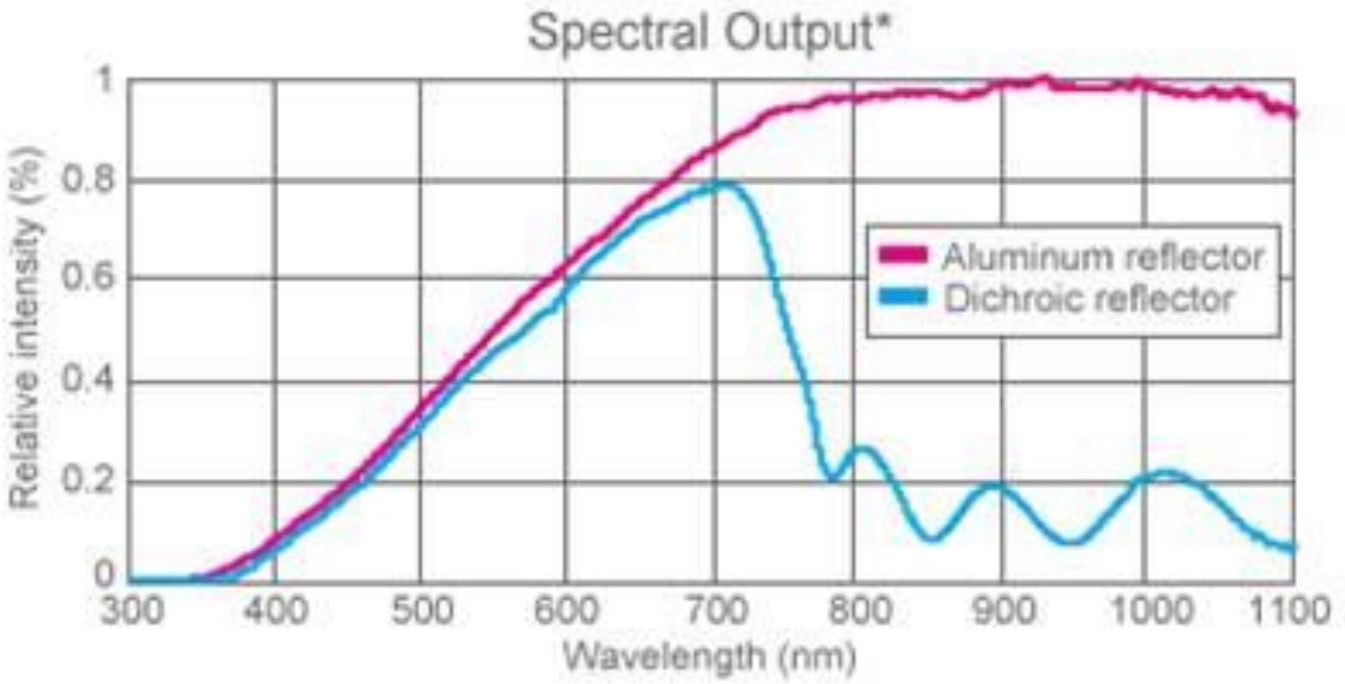

Figure 6: Spectral Output of Integrated Light Source

Please contact CytoViva directly at info@cytoviva.com to learn more about the ability to spectrally detect and comprehensively locate the presence of nanomaterials and surface coatings in the SWIR wavelengths or the the visible near infrared (VNIR) range. This can include conducting test imaging of your samples.