Silicon Wafer Analysis Using CytoViva Hyperspectral Microscopy

There are a number of different analysis methods used to identify defects and contaminants and to conduct efficacy tests on silicon wafers. This includes Raman microscopy, atomic force microscopy and e-beam analysis. However, these modalities are typically considered low throughput and alone they are often not sufficient for the large area spatial analysis that is commonly needed for silicon wafers.

To improve silicon wafer analysis throughput, CytoViva's Hyperspectral Microscopy and macro scale hyperspectral imaging has emerged as a highly effective defect and contaminant analysis method, as well as, a tool for wafer efficacy testing. This can include silicon wafers used in photovoltaics and other semiconductor applications and sapphire wafers used for LED and related applications.

Figure 1: CytoViva Hyperspectral Microscope.

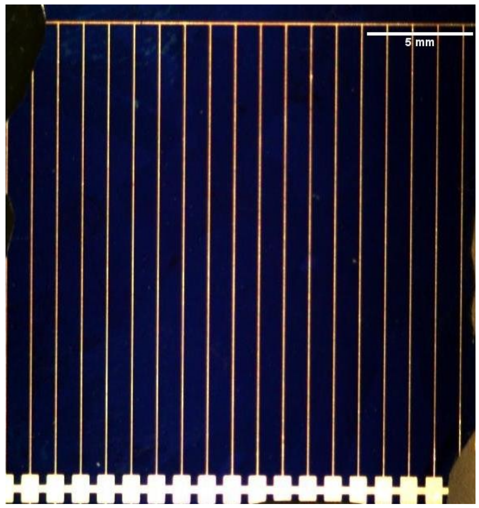

Figure 2: Hyperspectral Macro Image of Silicon Photovoltaic Sample.

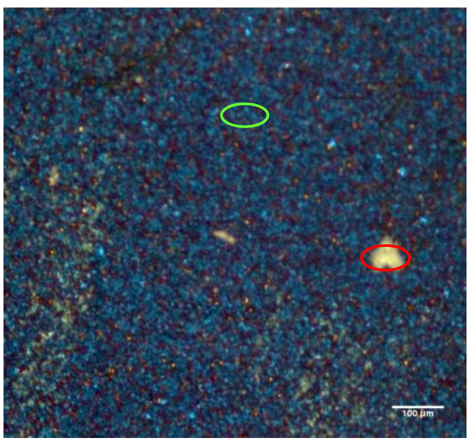

Figure 3: Hyperspectral Image of Silicon Photovoltaic Wafer at 10x Magnification.

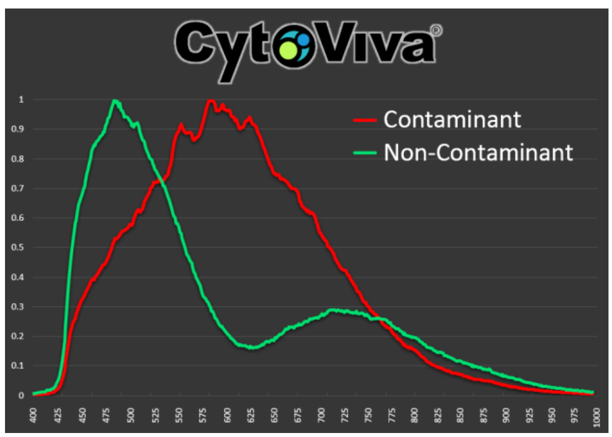

Figure 4: VNIR Reflectance Spectra of Contaminant and Non-Contaminant Area.

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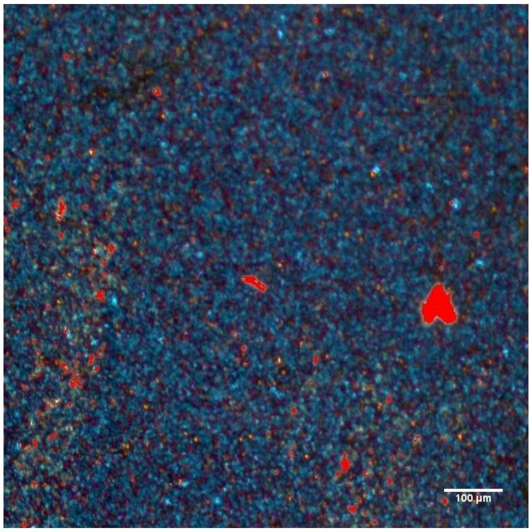

Figure 5: Mapping in Red of All Contaminant Spectrum.

Classification Distribution 484,416 Points		
Class Name	**Npts**	**Percent**
Unclassified	**480078**	**99.104%**
Contaminant Mapping Areas	**4338**	**0.896%**

Figure 6: Automated Class Distribution Report of the Total Area Containing Contaminants in the Silicon Surface Area.

CytoViva's Hyperspectral Microscopy captures the optical spectral response in the visible near infrared (VNIR) spectral range (400nm-1,000nm) or the short wave infrared (SWIR) spectral range (900nm-1,700nm). The spectral response of the scatter or florescence emission from the wafer surface is captured as reflectance spectrum in every pixel of the image. Spectral resolution in each pixel is captured at 2nm in the VNIR range and 5nm in the SWIR range.

An example of contaminant detection in a silicon photovoltaic wafer with CytoViva's Hyperspectral Microscopy technique is shown above in figure 3. In this example, a hyperspectral image of the sample is captured at 10x magnification. The image area is approximately 1mm x 1mm and was captured in under three minutes, with each 1.28um x 1.28um pixel containing the full VNIR spectrum. Example pixel level VNIR reflectance spectrum is shown in figure 4. Note that the contaminant spectrum illustrates a broad reflectance across much of the visible spectral range while the non-contaminant areas demonstrate preferred absorbance of the spectrum in much of this wavelength range. In figure 5 above, an automated spectral mapping algorithm identifies all of these contaminant areas in the image based on their unique spectral profile and maps each pixel red. Figure 6 shows an automated class distribution report which quantifies the amount of silicon surface area containing the contaminant spectrum.

This application note demonstrates how CytoViva's Hyperspectral Microscopy can effectively support defect and contaminant detection on silicon photovoltaics and a wide range of other similar surfaces. This can also include measuring fluorescence emission spectrum from coated sapphire wafers for LED applications and silicon wafers for other semiconductor related applications. Relative to other techniques such as AFM, Raman or e-beam, hyperspectral microscopy can perform this analysis at much higher throughput. To learn more about CytoViva's Hyperspectral Microscopy technology and how it can support your research or high throughput quality control needs, please contact us at info@cytoviva.com. We will be pleased to test image your samples or organize an onsite demonstration if appropriate.

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