Solar gets visible and NIR inspection

Knowledge Base

Engineers analyzing data from inspection systems for PV (photovoltaic) solar wafers and cells or bare boards can benefit from examining images captured simultaneously in both the visible and NIR (near-infrared) bands. Although a camera based on either a multispectral sensor or multiple single-band sensors can capture images in both bands, getting usable, simultaneous, high-quality images in both bands from a single camera is not easy, said Richard Meester, president of Quest Innovations, based in The Netherlands.

Q: What is the value of simultaneous visible and NIR inspection using a multichannel, multispectral parallel imager?
A: With parallel waveforms of the same item in one image, you can calculate the exact wavelengths for each material. First, you identify the waveforms of interest using a spectrometer to differentiate the wavelengths of different materials. Then, you can build a camera that identifies those specific wavelengths to improve inspection throughput. Because the wavelength of copper traces is different from the wavelength of a PCB's substrate material, you can use multispectral visible/NIR images to determine if the circuit traces are correct. You can also see how heat is generated inside the electronics or the chip, and how it flows over the board.

Q: How is this useful in solar-cell inspection?
A: Cracks in solar panels are hard to see in visible light, and each crack decreases a panel's efficiency. If you take the different materials' wavelengths, add a NIR image, and calculate every pixel between those wavelengths, you'll see a shift in the value of those calculations at the crack's location. This produces an image that includes visible and nonvisible wavelength information so you can detect different artifacts of the same crack. Simultaneously using the visible and NIR sensors ensures that you get information about the same area.

Q: What are the challenges of combining visible and NIR sensors?
A: Our five-channel Condor-1000 MS5 camera combines three visible light sensors, one each for red, green, and blue, with two NIR sensors on a spectral separation prism. Each sensor can be controlled separately to change settings such as synchronization, exposure, and region of interest. You must focus each sensor for the particular wavelength it is built for to get the sharpest possible image. Sensors must also be aligned, preferably with the lens they will be used for in the application.

Although combining multiple wavelengths on a single sensor is cheaper than creating one sensor per wavelength, a multispectral sensor only generates information from different wavelengths on different positions on the chip. You can't use these sensors to create an image of one position on the chip using different wavelengths.

Q: What's next in multispectral visible/IR cameras?
A: Our current camera has silicon sensors for IR up to 1000 nm. We're working on one that

mixes silicon sensors with InGaAs sensors for SWIR [short-wave infrared] wavelengths up to 2400 nm. This would allow simultaneous surface and through-wafer semiconductor inspection. We can also incorporate the
Foveon layered color sensor. This produces registered color on one channel, so we could make a camera with RGB, NIR, and SWIR with only three prism ports. This keeps down cost and complexity, and makes lens development easier.

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