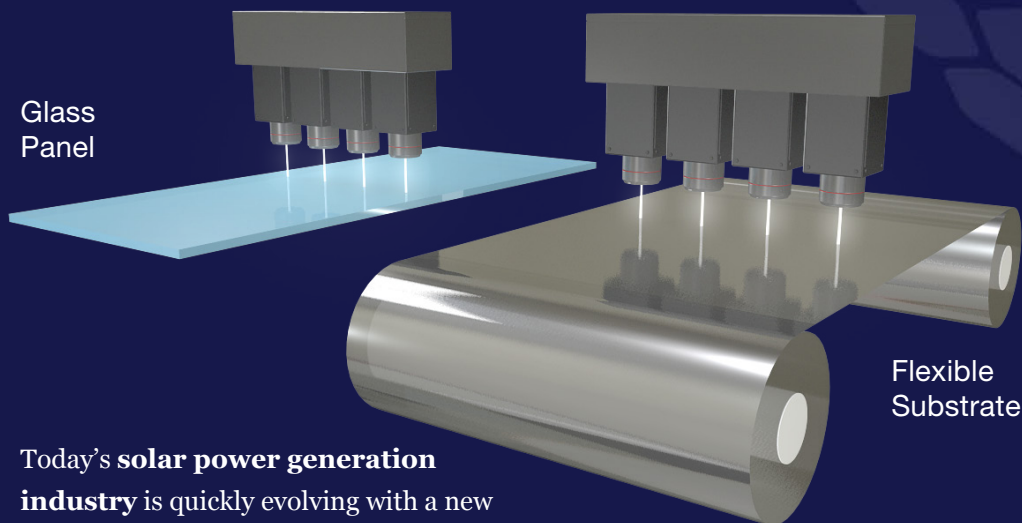




k-Space Associates, Inc.

BandiT PV In-Line Process Monitoring

for CIGS, CdTe, CIS, & Silicon PV Materials



Today's **solar power generation industry** is quickly evolving with a new breed of compound semiconductor materials leading the charge. These new, thin-film based materials have already surpassed performance requirements needed for global deployment. However, mass production and yield problems have limited broad commercialization of these promising thin-film PV materials. A key factor in producing the highest efficiency cells at the lowest cost will be the successful deployment of automated high-volume production with tight process control. To achieve this goal, it is essential that monitoring methodologies be implemented for higher conversion

“Measure Optical Properties in Real-Time to Increase Yield and Performance”

efficiency and reduced manufacturing costs. This includes implementing in-line metrology tools that monitor the performance metrics of the thin-film photovoltaic materials being produced so that the manufacturing process variables can be controlled and optimized in real-time.

k-Space has directly addressed this important in-line metrology need with our kSA BandiT PV system. This revolutionary system directly measures key parameters such as surface roughness, layer thickness, optical band gap, temperature, and other thin-film properties critical to PV device performance. kSA BandiT PV spectrally analyzes diffusely reflected light via solid state electronics to enable measurements over a wide spectral range. Modular designs and flexible geometries allow for rapid measurement at multiple locations across either glass panel or flexible substrate processing lines.



Performance Specifications

Optical Property	Parameter Range	Accuracy	Run to Run and Tool to Tool Repeatability
Optical Band Gap	425-1725 nm (0.7-2.9eV)	+/- 1	+/- 0.15
Metal Film/Substrate Temperature	250-1000 (°C)	+/- 2	+/- 1
Semiconductor Film/Substrate Temperature	RT-700 (°C)	+/- 2	+/- 1
Film Thickness	1-4 (um)	+/- 0.1	+/- 0.1
Film Roughness	>0.1% Change	NA	NA

Options

Unit #	Description
B-NIR-PV	Spectrometer and optics tailored for CIGS and Silicon PV material spectral analysis in the range of 920-1720 nm.
B-VIS-PV	Spectrometer and optics tailored for PV material spectral analysis in the range of 340-940 nm for CdS, CIS, and CdTe related materials.
B-PV-MP	Multiple spectrometer and optical head package. Allows for up to 4 simultaneous kSA BandiT PV measurements at multiple locations across panel/web for process uniformity analysis.
B-PV-SD	Linear scanning stage, optical head, and software for up to 300 mm of travel across panel/web. Provides access to any discrete sampling location for process uniformity analysis.
B-PV-AOS	Offline data analysis software key.