

# NEW! NEXT GENERATION!

## kSA BandiT

## Temperature Monitor

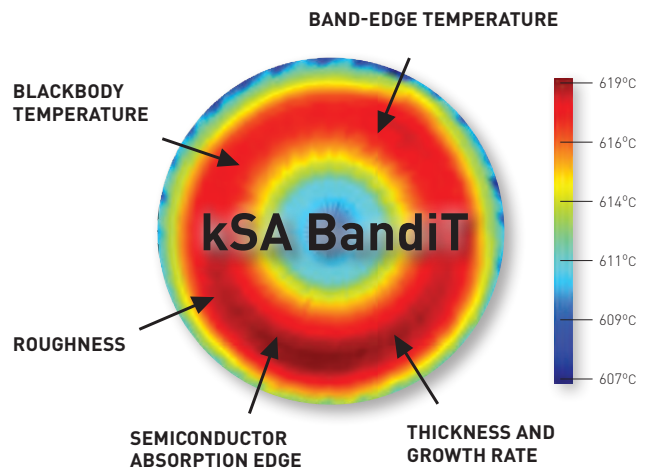


k-Space Associates, Inc.

### THE MOST ADVANCED TEMPERATURE MONITOR, PROVEN FOR TODAY'S MATERIALS

### NOW WITH BLACKBODY TEMPERATURE TECHNOLOGY, THICKNESS & ROUGHNESS

The kSA BandiT is a non-contact, non-invasive, real-time, absolute wafer temperature sensor. Using the temperature-dependent optical absorption edge of semiconductor materials, the kSA BandiT provides wafer temperature monitoring in ranges that pyrometers cannot measure: substrates transparent in the IR (including GaN, SiC and ZnO), as well as low temperature monitoring, e.g., LT GaAs and Si deposition. Combining that capability with a novel Blackbody emission monitor, kSA BandiT has the ability to monitor the full range of temperatures for most any substrate material, including low band gap substrates and metal films. Because kSA BandiT is insensitive to changing viewport transmission, stray light sources, and signal contribution from substrate heaters, kSA BandiT is the most accurate and repeatable optical method



for measuring true substrate or film temperature. Real-time film thickness determination and surface roughness monitoring are also included.

#### > FEATURES

- Single or multi-wafer with 2D temperature mapping
- Mount to any chamber
- Immune to stray light from hot filaments and heaters
- Immune to emissivity changes and viewport coatings
- Immune to substrate wobble
- Roughness measurement
- Blackbody temperature
- Temperature measurement of IR transparent substrates and films
- Room temperature measurements of most semiconductor substrates
- Thickness and growth rate determination
- Broad band pyrometry

#### > BENEFITS

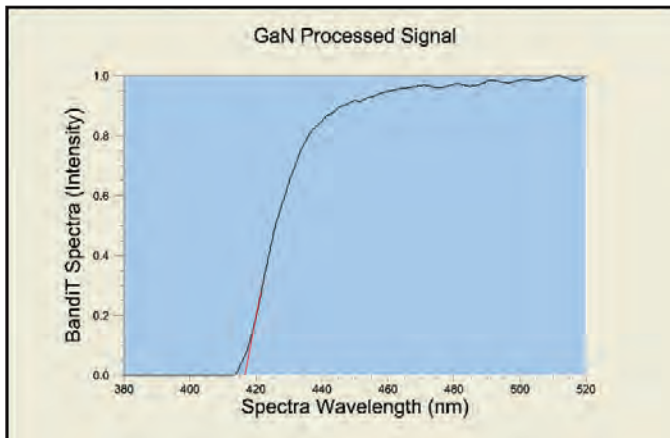
- Direct, accurate wafer temperature measurement of most semiconductor materials
- Unmatched temperature reproducibility
- Interfaces to deposition control systems via analog output or TCP/IP interface
- Proven for all semiconductor materials

# kSA BandiT Capabilities

## TEMPERATURE

### BAND EDGE

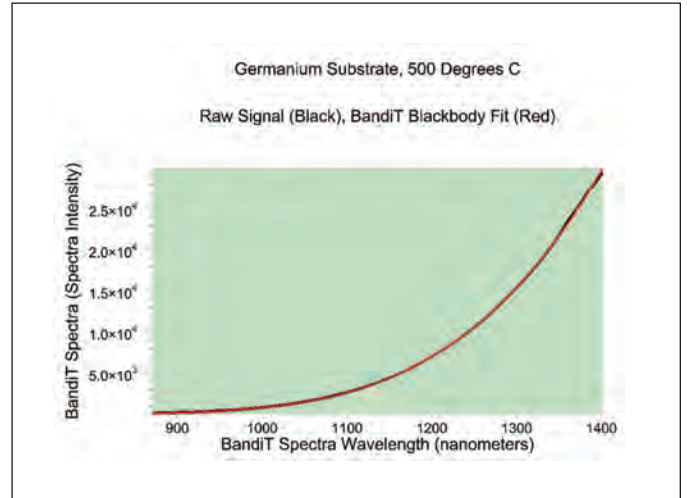
kSA BandiT band-edge based technology relies upon the direct semiconductor optical absorption shift with temperature (band gap dependence on temperature). By fitting the optical absorption edge of the semiconductor in real time and using substrate-specific, kSA-generated calibration files, measurement accuracy and repeatability are guaranteed and unmatched by any other optical temperature monitoring technique. Insensitive to changing viewport transmission, stray light sources, and signal contribution from substrate heaters, kSA BandiT provides a viable solution for wafer temperature monitoring where pyrometers cannot measure. Compatible substrate materials include InP, GaAs, GaP, SrTiO<sub>3</sub>, Si, GaN, Ge, SiC, ZnO, CIGS, CdTe and many other semiconductor materials. All substrates can be measured from room temperature and higher.



3.2um GaN film band edge on sapphire 750 °C

### BLACKBODY

kSA BandiT also combines a new patent-pending BlackBody emission monitoring technology whereby the spectral radiation intensity of a sample is fit in real time to Planck's equation to determine temperature. Direct chamber calibration via the band edge technique or high

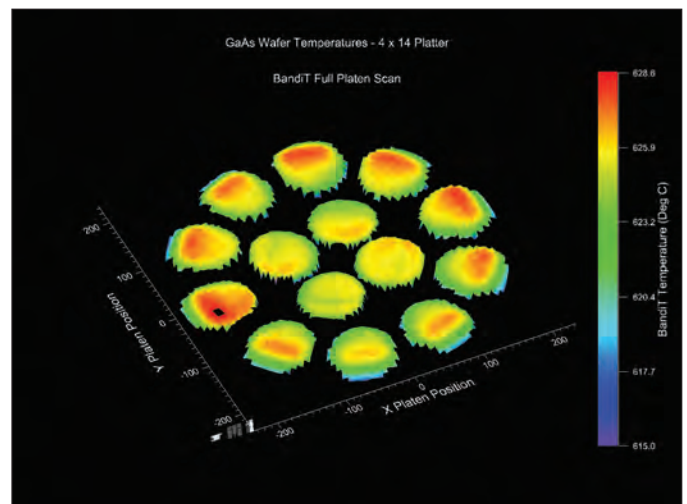


Blackbody signal and fit of radiation from Ge substrate @ 500 °C

temperature blackbody auto-calibration ensures run-to-run repeatability and unmatched resolution (better than 0.05 degrees). kSA BandiT BlackBody technology is compatible with all semiconductor substrates as well as metal films from 300 °C and higher.

### TEMPERATURE MAPPING

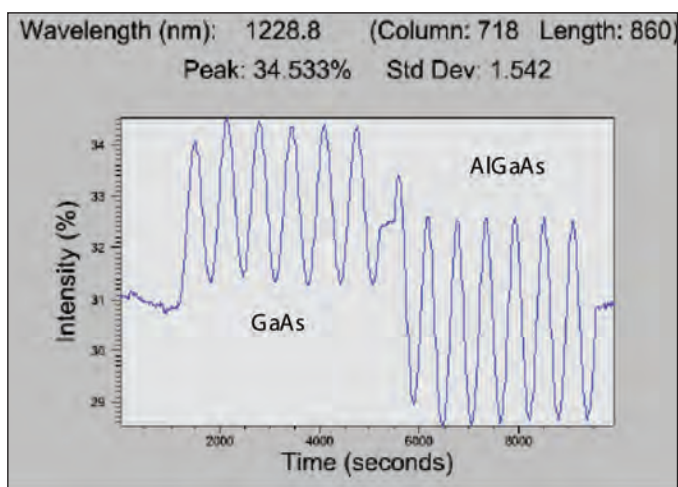
By integrating a servo motor-driven detector optics package, kSA BandiT is the only temperature monitoring technique which can provide full 2D temperature mapping.



BandiT Platen Mapping

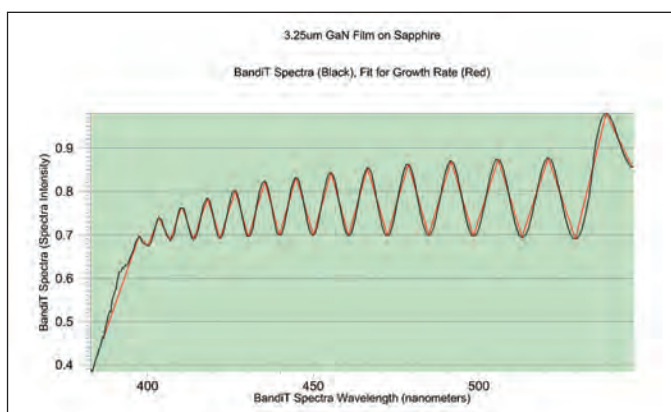
## THICKNESS AND GROWTH RATE

kSA BandiT has the ability to determine deposition rate from thin-film interference oscillations in the radiated light from the sample. This analysis is typically accurate to within 1% of the actual film thickness, and is performed post-deposition.



Pyrometric Oscillations

A second approach included for thin-film thickness determination utilizes the wavelength-dependant interference fringes present in the spectra. By analysis of extrema positions in the below gap spectra, the thickness of the film can be determined to within 1% accuracy, in real time during deposition.



Spectral Peak Analysis

## SURFACE ROUGHNESS

By monitoring changes in diffuse reflectivity signal vs. wavelength, kSA BandiT can provide a qualitative measurement of surface roughness.



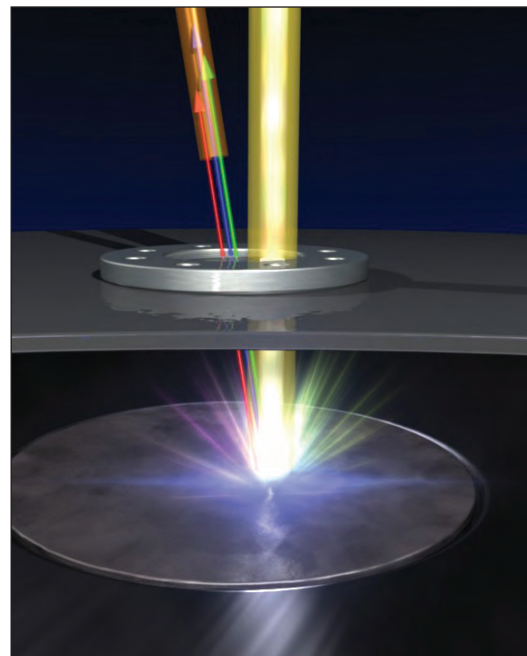
Diffuse scatter signal decreases with Ga liquid layer formation during MBE GaN growth

## SEMICONDUCTOR OPTICAL ABSORPTION EDGE

kSA BandiT monitors the optical absorption edge of a semiconductor film at most any temperature. This capability allows for real-time 'tuning' of optical properties related to the semiconductor band gap during the deposition process.

## > PERFORMANCE SPECIFICATIONS

<b>Substrate Material Capability</b>	GaN, GaAs, SiC, InP, ZnO, Si, ZnTe, Ge, CdS, CdTe, SrTiO <sub>3</sub> , GaP, GaSb, InAs
<b>Temperature Range</b>	> RT band edge > 300 °C Blackbody
<b>Accuracy</b> <b>Repeatability</b>	2 °C 0.5 °C
<b>Resolution</b> GaN, SiC, ZnO GaAs, InP, Si	+/- 1.5 °C band edge +/- 0.1 °C band edge, 0.05 °C BB >600 °C
<b>Stability</b> GaN, SiC, ZnO GaAs, InP, Si	+/- 1.0 °C +/- 0.2 °C band edge, +/-0.05 °C BB >600 °C
<b>I/O Communications</b>	Analog, TCP/IP

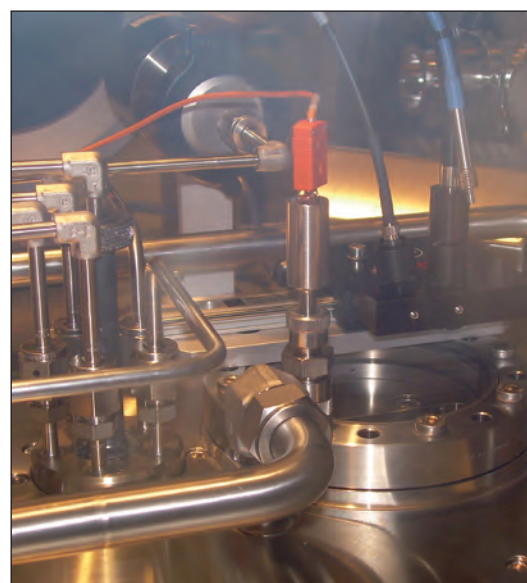


Schematic of BandiT white light source and detector.

## > HARDWARE AND SOFTWARE OPTIONS

Unit Name/ Part Number	Description
<b>BandiT-NIR*</b> B-NIR-MBE/MOCVD	Spectrometer and optics tailored for spectral analysis in the range of 875-1400 nm
<b>BandiT-VIS*</b> B-VIS-MBE/MOCVD	Spectrometer and optics tailored for spectral analysis in the range of 350-600 nm
<b>OPTIONAL UPGRADES</b>	
B-MWP	kSA BandiT Multi-Wafer Production Software
B-MWSD	Platen scanning capability for full 2D temperature map
kSA MOS kSA RateRat	Integrated stress, reflectivity and growth rate

\* Note: In addition to band-edge and blackbody temperature measurements, all BandiT units come with integrated, broad band pyrometry.



kSA BandiT on Aixtron™ G3 MOCVD system.

New optics hardware allows kSA BandiT to mount to most MBE, MOCVD, or custom deposition chambers. Integration of other kSA technologies such as kSA MOS for real time curvature and stress measurement is now available.

## YOUR PARTNER IN THIN FILM CHARACTERIZATION

**k-Space Associates, Inc.**, is a leading supplier to the surface science and thin-film technology industries. Since 1992, we've delivered the most advanced thin-film characterization tools and software thanks to close collaboration with our worldwide customer base. We realize the best products are developed with our customers' input, so we're good listeners. For your real-time surface analysis, curvature/stress, temperature, deposition rate, or custom project, we look forward to helping you with your thin-film characterization needs.