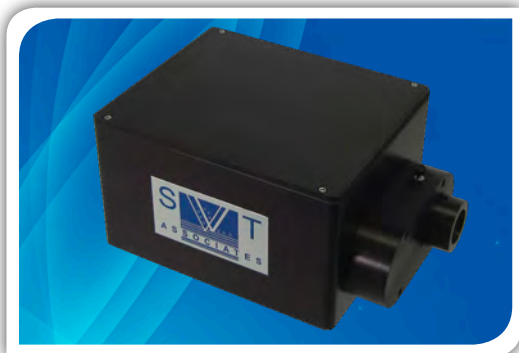


AccuTemp™ Process Monitor

Real-Time Measurement of Temperature and Growth Rate

Engines for Thin Film Innovation



Description

The AccuTemp (*In-Situ* 4000) process monitor is an ideal solution for closed-loop monitoring and control of multilayer thin film growth applications such as MBE, MOCVD, and CIGS. The AccuTemp system provides real-time and accurate information on the substrate temperature, film thickness, and growth rate using a single normal incidence view-port. Temperature is measured using a two color infrared pyrometer specifically designed to be insensitive to window coating and alignment errors. The radiometer compensates for changing emissivity and corrects the pyrometry measurements. An optional Bandgap Module allows for monitoring of low substrate temperatures, and easy calibration of the pyrometer. Two independent optical reflectometer signals are analyzed to provide thickness, growth rate, and refractive index in real-time.

Typical Applications

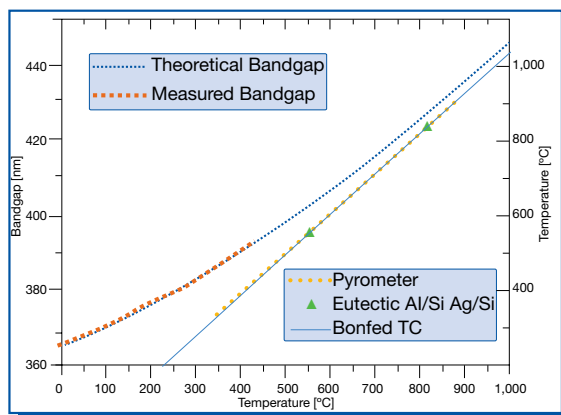
Typical application materials for the AccuTemp include, but are not limited to, GaN, GaAs, ZnO, CIGS, Si, ZnTe, SiC, MCT, and STO. The AccuTemp is used to collect temperature and growth rate data for reproducibility in the R&D setting, yet is versatile enough to be used as a monitoring and automation tool in the production environment. The Bandgap Module allows for temperature monitoring at temperatures below the range of a pyrometer such as GaAs, GaSb and Si applications.

Features

- Real-time Measurement of Temperature and Film Thickness on a Single View-port
- Dual Wavelength for Window Coating and Substrate Transparency Compensation
- Emissivity Compensation for “True” Temperature
- Closed-Loop Control of Temperature and Film Thickness
- Optional Bandgap Module for Low Temperature Measurement and Calibration

Specifications

Temperature Ranges Pyrometer	450 °C – 1,300 °C
Bandgap Module	RT – 700 °C
Compatible Substrates	Si, GaAs, InP, Sapphire STO, GaSb, MCT, ect.
Radiometer Wavelengths	950, 850 nm
Temperature Equivalent Noise	< 0.5 °C @ 450 °C Si
Reflectometer Wavelengths	950, 470 nm
Reflectometer Equivalent Noise	< 1 nm @ Films > 100 nm
Target Distance Range	400 mm to infinity
Measurement Spot Size	> 7 mm Ø
Viewport	2.75" CF (4.5" CF for Bandedge Add-on)
Dimensions	100 x 140 x 130 mm
Alignment	Video Monitor
Computer Requirement	Windows XP, Serial Port Interface

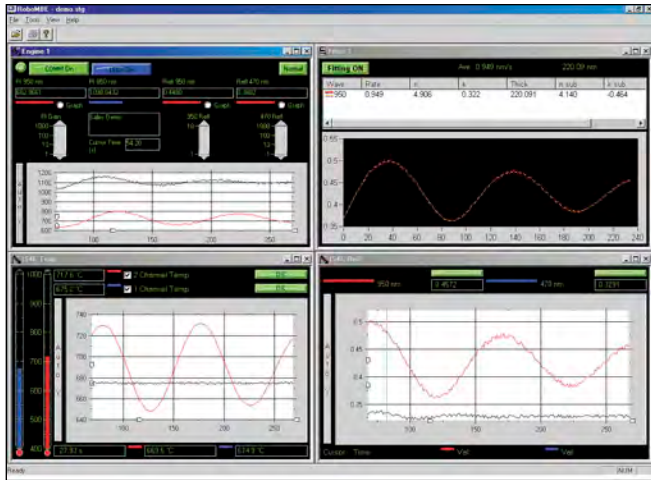


Pyrometer and bandgap module temperature data for GaN substrate.



AccuTemp™ Process Monitor Software Applications

Engines for Thin Film Innovation

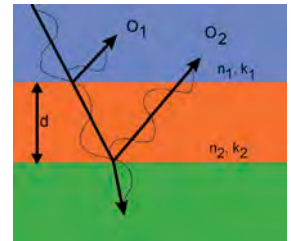


Software Description

The AccuTemp software application is fully integrated into SVT Associates' RoboMBE™ software automation and control system. The AccuTemp application performs the data acquisition from the optical head, displays the emissivity compensated temperature of the substrate in real time, and computes the specular reflectance of the substrate. The user-friendly graphical interface allows each of the measured variables to be displayed on the screen numerically, or in moving "strip charts." Collected data is stored in spreadsheet format and is compatible with most spreadsheet software for analysis. The optional Bandgap Module has an integrated reference chart to allow for a wide range of material compatibility. Tilt errors experienced during substrate rotation are easily eliminated by the built-in wobble filter.

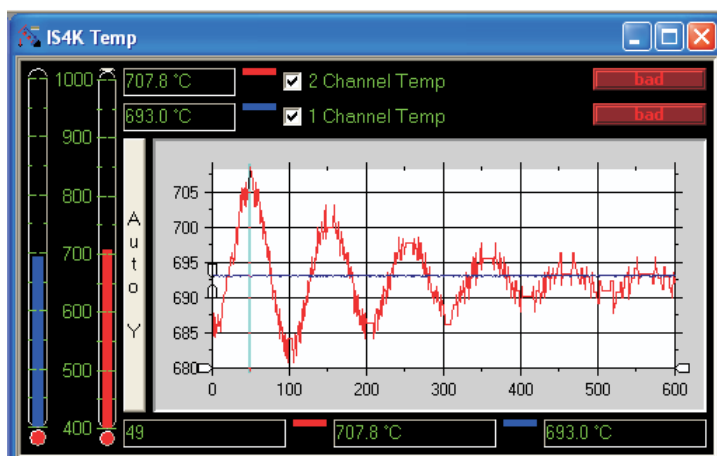
Growth Rate and Film Index Fitter

The optional Growth Rate and Film Index Fitter software module provides real-time growth rate, film thickness, and index of refraction. The period of the oscillation, amplitude, phase and damping characteristics of the reflectance data are dependent on the film's index of refraction. The growth rate fitter software processes the reflectance information and displays a current growth rate for a given film by fitting to a multi-parameter analytical model. The film index fitter allows computation of the film index of refraction. The Layer Sequencer offers a method to automate and monitor the fitting of many different successive layers such as VSEL structures. This enables the user to develop complex layer recipes for stacks of multi-layers.

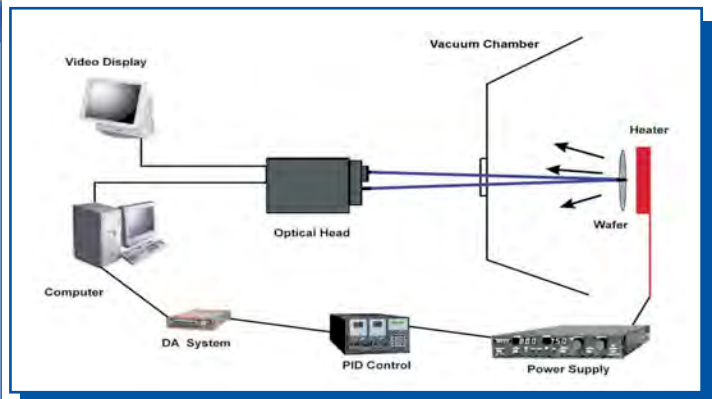


Remote Control Interface

The optional Remote Control Interface allows for the data being taken by the AccuTemp system to be used for process control functions via the RS232 link. The AccuTemp uses USB linked Data Acquisition System to allow for closed loop shutter and heater control. The Data Acquisition System can be interfaced with a PID controller for a substrate temperature control via an analog signal. The Data Acquisition can also provide control for up to four material source shutters with digital signal outputs.



The AccuTemp Process Monitor Software Package has multiple filters to display accurate and reproducible data. The red signal is an unfiltered signal from the pyrometer, while the blue signal is the emissivity corrected data.



The schematic for full integration of the AccuTemp Process Monitor Remote Control Interface System.

