IL550 & IL560 Series Optical Monitors

for

The ULTIMATE in Thin Film Coating Precision, Accuracy & Control
Product Range

In-situ, real time measurement systems for thin film coating and etching applications

Crystal Monitor / Control Systems (Xtal) for monitoring and controlling material growth rates, typically in simple vacuum deposition systems.

Optical Monitor / Control Systems (OMS) for monitoring and controlling material growth rates, typically in complex vacuum deposition systems.

Laser End Point Detection Systems (LEPD) for monitoring and controlling material etch rates, typically in reactive ion etching systems.
Intellevation – A new company with a long history

Intellemetrics Ltd (1982 to 2004)
- World renowned name in Precision Optical Monitoring Systems
  - 24 years of expertise providing solutions for Vacuum Processing
  - Well designed robust products
  - High performance / specification products
  - Cutting edge application specific control & modelling software

Intellevation Ltd (2004 onwards)
- Formed in Dec 2004
- Acquired the Intellemetrics business from BOC
- Company owned by the Intellevation Directors
- Invested in a restructuring program to enhance its core skills of;
  - Research
  - Product Design & Development
  - Applications Development
  - Customer Support & Training
  - Marketing
  - Quality & Manufacturing
World-class Design and Applications Development Team

Management team includes:

- **CEO: Dr Simon Hicks**
  Previously a Dry Etch Facility Manager with 12 years experience developing dry etch processes for optoelectronics, MEMS and electronics applications. Subsequently an Entrepreneur leading all aspects of a number of high-tech start-up ventures.

- **Technical Sales Director: Mike Biagi**
  30 years of experience in the growth of precision optical coatings for research, commercial and military applications. Subsequently many years experience in vacuum process monitoring instrumentation.

- **Technical Director: Dr Dave Reeve**
  30 yrs experience in the design of optical instrumentation solutions for vacuum systems including cutting edge software modelling and control systems.

- **R&D Director: Bill Beckmann**
  Previously General Manager of Intellematics Ltd. 30 yrs experience in the design of optical instrumentation solutions for vacuum systems.

- **Senior Mechanical Design Engineer: Danny Furey**
  25 yrs experience in the mechanical design of optical instrumentation solutions for vacuum systems.

- **Senior Electrical Design Engineer: John McGonigle**
  20 yrs experience in the electronic design of optical instrumentation solutions for vacuum systems.
Manufacturing & Quality

Quality is important to us.

Our manufacturing is performed using:

- Formal Quality Systems
  - ISO 9001 / 14001 Certifications
- State-of-the-Art equipment / processes
  - Supply Chain Management
  - Assembly
  - Testing
  - Qualification
  - Direct Fulfilment
  - Aftersales Logistics & Repair
Why Use Optical Monitoring?

- Quartz crystal measures the deposited mass
  - Typical accuracy ± 1% - actual error increases with thickness and layer complexity

- Optical Monitoring measures the true **Optical Thickness**

- Inherent error compensation in optical monitoring
  - Film stack errors can **decrease** as layer thickness and complexity increases

- Achievable repeatability ± 0.01%
  - **Example**
    - 34 layer non-QW design bandedge filter
    - Bandedge repeatability run-to-run over many days
      - ± 1.6nm without Optical Monitoring (Crystal Monitoring only)
      - ± 0.1nm with Optical Monitoring

- Optical Monitoring is becoming the preferred solution for a wide range of precision optical components

- Need to use crystal monitoring in conjunction with Optical Monitor in order to control deposition rates.
Optical Monitoring Vs Quartz Crystal Example

Target Specification

- **Product:**
  High Performance Steep Edge Notch Filter

- **Application:**
  Laser Protection Filter

- **Materials:**
  TiO$_2$ / SiO$_2$
  Ebeam deposition and IAD

- **Film Stack Design:**
  Demanding 30+ layer film stack with non-QW termination

- **Band Edge Position Spec:** ± 0.7 nm
Optical Monitoring Vs Quartz Crystal Example

Performance of film stacks produced over many growth runs using Quartz Crystal Monitoring compared with those produced using Intellevation’s IL551 Optical Monitor.

**Band Edge Position**
- **Quartz Crystal Monitoring**
  - Band Edge Spread > 3.3 nm
  - Poor Yield

- **Optical Monitoring**
  - Band Edge Position ± 0.1 nm
  - Very High Yield
IL550 & IL560 Series of Optical Monitors

- Add Precision, Accuracy & Certainty to YOUR Coating Process
- Provide real-time cutpoint capability for a wide range of precision optical coating applications.
- Automatically provides a cut based on a pre-programmed optical thickness for each film
- Automatically adjusts the monitoring wavelength for each layer
- Can cut either ‘On’ QW or ‘Off’ QW
- Supplied with a powerful suite of software to create one integrated precision coating monitor tool.

- Increase customer’s product Performance !
- Increase customer’s Yield !
- Drive down customer’s Costs !
Applications: 300 nm to beyond 12 µm

Simple Coatings
- Simple AR
- Broadband AR

Complex or Precision Coatings
- Beamsplitters
- Reflectors
- Laser Facets AR & HR
- Gain Flattening Filters
- Bandpass Filters
- DWDM Filters
- Longpass Filters
- Shortpass Filters

Crystal Monitor alone

Optical Monitor & Crystal Monitor Combination
Free Space System

Front surface reflection on a test glass

Back surface reflection on a test glass

Transmission on a test glass

Direct monitoring in transmission
Fibre Based System

High speed sampling
User variable from 2ms to 1 second

Dual fibre system working in transmission mode in a rotating drum sputter coater. System operates in an extremely high speed sampling mode.

Dual fibre system working in transmission mode monitoring a rotating work piece. Sample times from 2ms to 1 second.

Single fibre system working in back face reflection mode in an ebeam coater. The launch optics are integrated into Intellevation’s 20 position test glass changer.
Wavelength Ranges

Source Module: Quartz halogen 300 – 2400nm
Extension down to 250nm achieved with deuterium source

Detectors
- PMT: 250 - 800nm
- Silicon: 400 - 1100nm
- Peltier Cooled Si plus InGaAs: 500 - 1650nm
- Peltier Cooled Si plus ext InGaAs: 800 - 2000nm
- Peltier Cooled PbS: 1000 - 2400nm

Standard Products
- Free Space Systems
  - IL551: 300 – 800nm
  - IL552: 400 – 1100nm
  - IL553: 500 – 1650nm
  - IL554: 800 – 2000nm
- Fibre Based Systems
  - IL562: 400 – 1100nm
  - IL563: 500 – 1650nm

Other wavelength ranges available on request.
Accessories: Test Glass Changers

- In-house designs. Customised for your chamber geometry.
- Driven from Optical Monitor system for true integration and automation.
- Optional Integrated Multiposition Crystal Changer.
- Suitable for front or back face reflection and transmission optical monitoring modes.
- Optical alignment from outside the chamber, i.e. under vacuum.
- Up to 20 test glass carousel system or 250 glass drop glass system.
- Integrated carousel system for fibre based monitor retrofitted to your crystal changer.
Advanced Measurement System

- Free space optical method utilising;
  - High speed 4 phase chopped light source for high rate, low noise data collection in harsh coating environments.
  - Synchronous detection of Sample, Dark and Reference signals.
  - Signal and Reference share a common optical and electronic path for maximum drift immunity. Similar to a dual beam spectrophotometer.
  - Full digitisation of signals at the Detector Module for maximum electrical noise immunity.
  - Wavelength discrimination post chamber for maximum process induced optical immunity.

- **Result:** Robust precision measurement on YOUR system!
**Powerful Software**

- Intellevation’s Optical Monitors give thin-film engineers the tools to decrease process development time & manufacturing costs AND increase yield & product performance.

- The system combines advanced optoelectronic hardware with a suite of powerful software packages including:
  - **FilmMaker ©**
    - FilmBuilder ©
    - FilmModeller ©
    - FilmSimulator ©
    - FilmCharacters ©
    - FilmReviewer ©
  - **FilmDirector ©**

- to provide a single complete integrated solution.
Predictive modelling software – design a film structure from scratch and rapidly determine the optimum process conditions thereby reducing material waste & process development time.

**Key Features**

- Modelling allows the selection of optimum monitor wavelength & test glass for each layer.
- Single data entry screen
- Rapid input for QW stacks
- On screen help prompts
- Automatic & manual modes
- Automatic gain setting
- Simple (default) and Advanced screens
- Import and export of files
- Data consistency check
FilmModeller ©

- Automatically reads a FilmBuilder © file
- Calculates and displays the expected Optical Signal as a function of Deposition Time
- Snapshot of whole process
- Rapidly see the effect of your model design
- Provides guide to signal compression
- Provides guide to number of films per test glass.
- Suggests OM scheme options to try in FilmSimulator ©

Non QW stack

QW stack
**UNIQUE and POWERFUL feature not found in other packages**

- Off-Line simulation runs including
  - Optical Model
  - Physical effects of Optical Monitoring hardware
  - Physical effects of Customer’s Coating Tool
    - E-gun noise (material dependent)
    - Gun dep rate control
    - Test glass variations

- Calculates ‘cut point’ errors on a layer-by-layer basis

- See inside the process and identify where errors will occur

- Helps the coating engineer design a ROBUST process off-line
**FilmSimulator © in Action**

- Complex 26 layer film stack
- Multiple Non Quarter Wave design
- FilmSimulator © indicates cutpoint errors > 50%
- Proof that the product will be extremely unlikely to meet specification

**Action:** Modify growth scheme and analyse impact with FilmSimulator ©

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**Same film stack – different scheme**

- Change monitor wavelengths
- Change Test Glass scheme
- Change filter settings
- Change QW factors
- Change number of samples per QW

**Result:** massive decrease in cutpoint errors (< 1%) – the film stack performance is now achievable!

1 hour on FilmSimulator © saves many days of process development on the production line.
FilmCharacters

- Determine the Spectral Characteristics of the final film stack
- Compare the THEORETICAL DESIGN spectra with the ‘REAL-LIFE’ spectra from FilmSimulator
- See the impact of ‘cut point’ errors on the performance of your final product!
- Powerful production process design tool
- Plot many simulated runs on the same graph
  - gain real information on process YIELD – OFFLINE!

Complex non-quarter wave design. FilmCharacters® shows the designed response and the run-to-run variability – even before a run is done.
FilmDirector ©

- A fast and easy-to-use front-end that enables you to drive your process.
- Loads a process from FilmMaker ©
- Performs the run under automatic or manual control as required
- Autocalibrates on start up
- **FilmDirector ©** automatically changes the wavelength and the test glass
- Detects each cut and controls the material sources and shutters through an advanced I/O capability.
Key Features

- Incorporates advanced model fitting algorithms for cutpoint determination
- State machine based controller can recover/continue a process context even after a shutdown.
- Integrates seamlessly with "FilmMaker©" design front-end.
- Freely configurable, panelled user-interface.
- Now includes two operating modes.
  - **ADVANCED** mode for process developers allows access to all of the parameter space.
  - **BASIC** mode enables an ADVANCED user to lock and hide many of the advanced parameters thereby providing a clear front-end for a previously optimised process, ideal for use by operators in a manufacturing environment.
- After a run is completed, the data is logged for later analysis. Files can be exported in CSV format for analysis in your favourite program.
**FilmReviewer** © is used to view, analyse and reprocess previous runs – for **OFF-LINE OPTIMISATION**.

- Take **REAL RAW DATA** from your coating system, and observe the effects of reprocessing it, changing the filtering parameters, the sampling rate, the latency and hold-off parameters and the termination algorithms.

Load RAW DATA from previous runs on a layer by layer basis

View the raw data for the whole stack or analyse a layer at a time

Reprocess the data on a layer by layer basis to optimise future runs

Change Acquisition Settings, Turning Point Analysis Settings and Analyser Mode and see the impact on accuracy of cutpoint determination.
Installation

Our skilled engineers will install and commission our monitor systems directly onto your coating system ✓

at your facility ✓

and provide initial on-site operational training ✓
Training & Support Products

Intellevation’s growth and optical monitoring experts provide:

- **Post Installation Training Packages**
  - Face-to-face training at the customer’s facility…
  - On the customer’s coating machine…
  - Tailored to the customer’s specific experience & process…
  - Duration determined by customer’s needs…
  - Aims to provide customer with the necessary practical experience in coating machine set-up, optical monitoring, and optical process design to rapidly achieve their precision coating goals.

- **In-House Training Packages**
  - As above but at our coating facility using our equipment…

- **Process Development Packages**
  - Theoretical thin film design, and growth scheme design consultancy…
  - On the customer’s coating machine…
  - Tailored to the customer’s specific experience & process.
Installation Base

We have successfully integrated our Optical Monitor Systems onto coating systems made by the following manufacturers;

- Balzers
- Satisloh
- Veeco
- Leybold
- Mill Lane Engineering
- Pfeiffer Vacuum
- Tecport Optics, Inc.
- BOC Edwards
- Oxford Instruments
- Nordiko
- Intec
- Elettroraya
- Provaco
- ProTech Korea Co., Ltd

General Vacuum

ElectroTech

and many more............
Thank You

For further information or support, please contact

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