

## QUANTITATIVE BIREFRINGENCE IMAGING SYSTEM

*Now it is possible to quickly and easily measure stress and structure in transparent materials...*

CRI's Abrio imaging system provides a unique method to measure and analyze low-level birefringence in samples. Traditional methods for measuring the spatial distribution of birefringence with polarized light are cumbersome and time intensive. Abrio technology opens the door to the world of birefringence imaging by automating the process of quantitative polarization microscopy, allowing you to accurately calculate retardance magnitude and orientation at every pixel within seconds.

### IMAGE AND MEASURE:

- Optical materials
- Glass
- Polymers
- Silicon wafers
- Thin films
- Aluminum
- Graphite

### KEY FEATURES:

- Quantitative retardance data per pixel
- Easy-to-use, interactive software
- Fast image acquisition (<3 seconds per image)
- Retardance sensitivity to 0.02 nm
- Turnkey system



## ABRIO IMAGING SYSTEM

Visualize and measure birefringent structures in transparent and some reflected-mode objects, such as glass, crystal, plastic, optical fibers, and aluminum at all pixels of an image within seconds!

The system consists of integrated microscope peripherals that combine a unique liquid crystal based polarized light contrast technology, controlling electronics, patented imaging algorithms and interactive software.

### ADVANTAGES

- Quantitative retardance magnitude and orientation data per pixel
- Automated calculations, including background correction
- Easy-to-use software
- Digital images for documentation and review

## QUANTITATIVE BIREFRINGENCE DATA SUPERIOR PERFORMANCE

Spatial resolution, data acquisition rate, measurement range, and sensitivity make the Abrio imaging system a superior tool for the analysis of stress and strain in injection-molded parts, polymer fiber in manufacturing, microstructures in cell biology, and compounds in the pharmaceutical industry.

### Automatic Retardance and Azimuth Data

The system will automatically calculate retardance and azimuth data per pixel in the image of the sample. Both raw and calculated data stacks can be stored for documentation and review.

### Background Correction

The system will automatically calculate out background information using patented algorithms to yield high sensitivity and accuracy.

### Orientation-Independent Polarization

Unique to CRI's Abrio imaging technology, the polarized image is independent from the orientation of the polarizers or the specimen. This results in an image of uniform brightness, detail, and clarity.

### Quick and Easy Image Acquisition

CRI's easy-to-follow software program lets you generate processed images within seconds.

### No Moving Parts

There is no need for manual manipulation of the polarizers or the specimen. Computer-controlled liquid crystal based optics yield perfect pixel-to-pixel image registration and accurate polarization control.

### Comprehensive Software Analysis Tools

Software tools are available to analyze various retardance magnitude and orientation parameters, including:

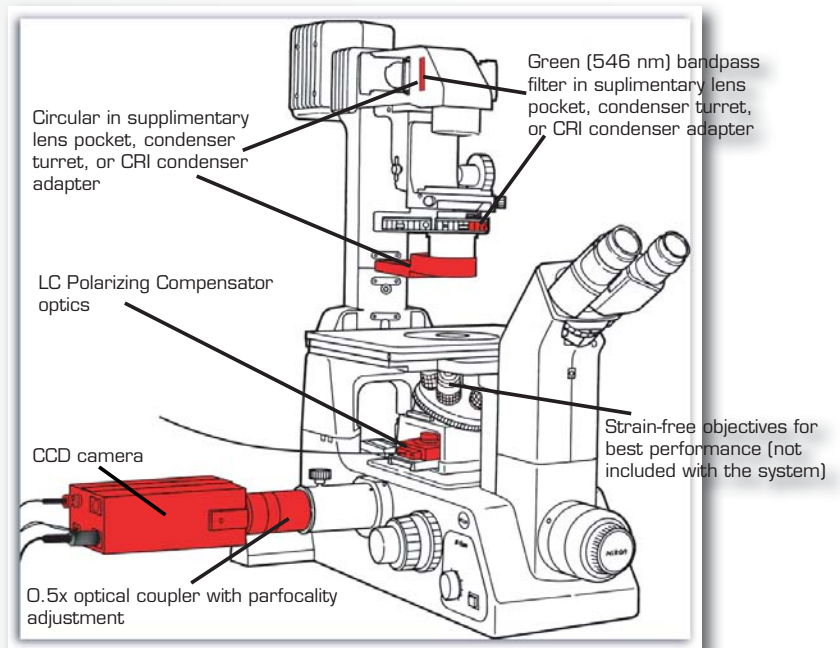
- Line scan
- Pseudocolor overlay
- Single-pixel measurements
- Vector overlay
- Thresholding
- Area calculations

## SYSTEM COMPONENTS

### Microscope Peripherals

#### Liquid crystal based polarizing compensator

The heart of the Abrio optical system is the liquid crystal (LC) component that changes the polarization state of the light with no moving parts, with noise, and—most importantly—with no image shift.



Typical LC-PolScope configuration shown on inverted microscope

*Green bandpass filter*

The 546 nm light filter will make images appear in high-contrast green when viewed through the eyepieces, and is necessary for the LC polarizing compensator optics.

*Circular polarizer*

The circular polarizer is placed between the light source and the specimen. The exact location is dependent upon your microscope brand and model.

*Optical coupler*

A 0.45x or 0.5x optical coupler is placed between the camera port of the microscope and the CCD camera. This increases the amount of light hitting the CCD, thereby reducing image capture time.

**CCD Camera, Computer, and Monitor**

These components, along with the pre-installed framegrabber PCI board, allow you to capture digital images. Digital images can be processed, archived, exported, or retrieved without loss of quality.

**SOLID-STATE: NO MOVING PARTS AND NO VIBRATION**

**Controlling Electronics and Computer Algorithms**

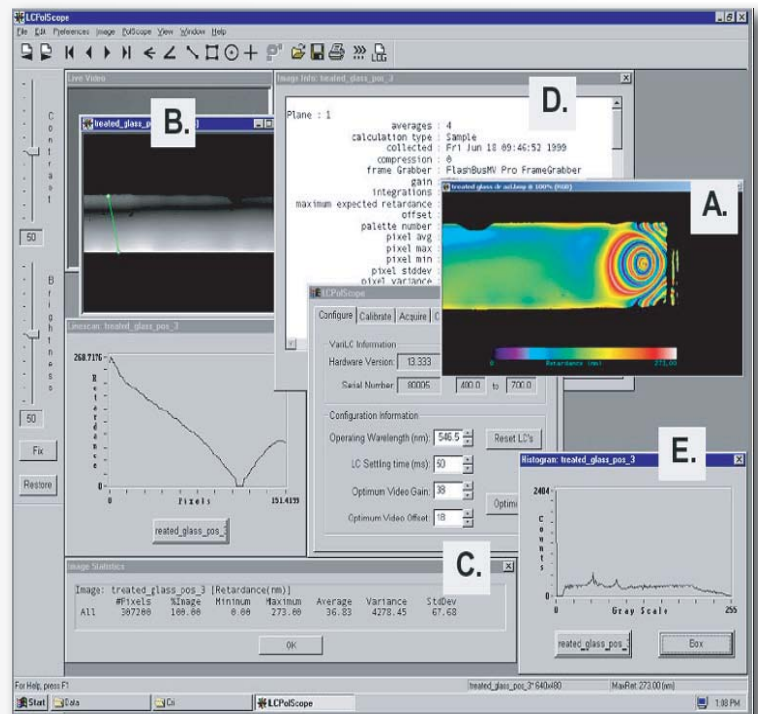
Orientation-independent polarization imaging is made possible using precise LC variable polarization, controlling electronics, and patented software algorithms. These work together to automatically change the axis of polarization and display composite images in perfect registration on the computer monitor.

Calculated magnitude and orientation images are produced by taking four grayscale images at different polarization settings (see the figure above). The LC tunable retarder—sometimes referred to as a universal compensator—and CCD camera are controlled by a host computer.

**Software**

CRI's integrated patented imaging software algorithms allow for the automatic capture of retardance image stacks with an easy-to-follow user interface.

The image stacks can be analyzed with various software tools. Some of the tools available include a pseudocolor overlay (Item A, in the figure below), line scan (Item B), area calculation (Item C), image report (Item D), histogram (Item E), azimuth vector overlay (not shown here), point measurements (not shown here), and many more.



### MICROSCOPE COMPATIBILITY AND OPERATION

The system is compatible with the following microscopes with C-mount camera ports:

**Upright microscope models**

- Nikon Eclipse series
- Leica DM-IRB
- Olympus BX-series

**Inverted microscope models**

- Nikon Diaphot 200/200, TE-series
- Zeiss Axioplan 1 and 2
- Olympus IX-series
- Zeiss Axiovert 200

*Note: Models listed are compatible with transmission light microscopes. Please contact CRI if your microscope is not shown here, or if you are interested in using a reflective-mode system.*

### Sample

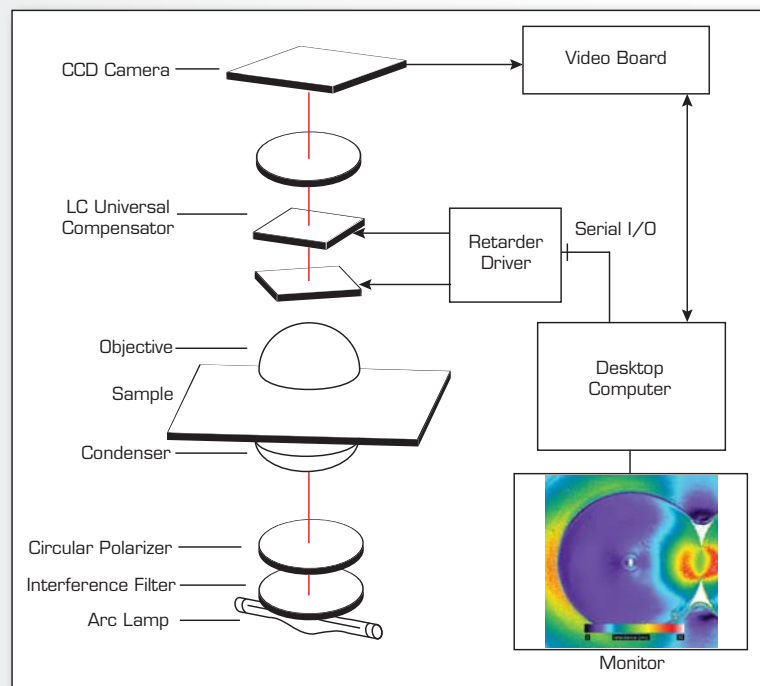
The birefringent nature of plastic interferes with image acquisition, so glass-bottom dishes, chambers, or slides are required. Contact CRI for more information on optimizing sample handling.

### Microscope Objectives

Strain-free polarized light objectives yield optimum performance, but are not required.

### SYSTEM OPERATION

The instrument design is based on the traditional polarized light microscope, in which the compensator is replaced with a so-called “universal compensator” manufactured from two LC devices. The computer-controlled universal compensator, together with electronic imaging and digital image analysis, is used to measure the specimen birefringence at every pixel of the image.



### About CRI, Inc.

Founded in 1985, Cambridge Research & Instrumentation, Inc. (CRI) is a photonics company and the leading provider of liquid crystal based imaging technology.

We offer a broad array of tunable solid-state optical components and modules for use in wavelength selection, polarization optics, and light modulation in digital imaging applications.

We also develop and manufacture high-performance instruments and systems that exploit multispectral and polarized-light imaging and detection for pharmaceutical drug discovery, life science and clinical research, and industrial process control.

CRI services a global network of distributors and partners through direct sales of systems and strategic alliances as an OEM supplier.

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### SPECIFICATIONS

#### Optical

Modes of operation	Transmission or Reflection
Retardance sensitivity	0.02 nm
Retardance range	0.02 nm to 260 nm
Wavelength of operation	546 nm
Spatial resolution	Unaffected
Optical coupler (C-mount)	0.45x to 0.65x

#### Electrical

Power supply	100–120 VAC, 60 Hz, 1 Amp 210–230 VAC, 50 Hz, 1 Amp
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#### Image acquisition

CCD chip dimensions	1/2-inch diagonal
Image size	640 by 480 pixels, 256 gray levels
Pixel dimensions	9.8 by 8.4 $\mu$ m
Image output format	BMP or TIFF (PC-format)

#### Computer platform

PC-compatible Pentium-class  
CPU with PCI-bus, 256 MB RAM  
minimum configuration

#### Operating system

Windows 2000 or later

#### Monitor

17-inch LCD, 1280 by 1024  
pixels, 24-bits or better