Microscopy from Carl Zeiss

Applications

AxioVision TIC

Measurement of layer heights

TIC Microscopy

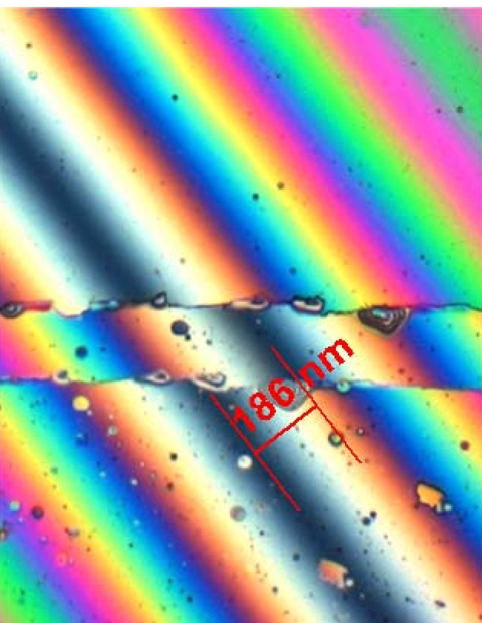
Examining the quality of thin layer systems places high demands on a microscopic measuring system. With TIC microscopy, Carl Zeiss offers not only optimum assessment of the sample, but also the non-contact, vibration-free and precise measurement of the heights of thin layers.

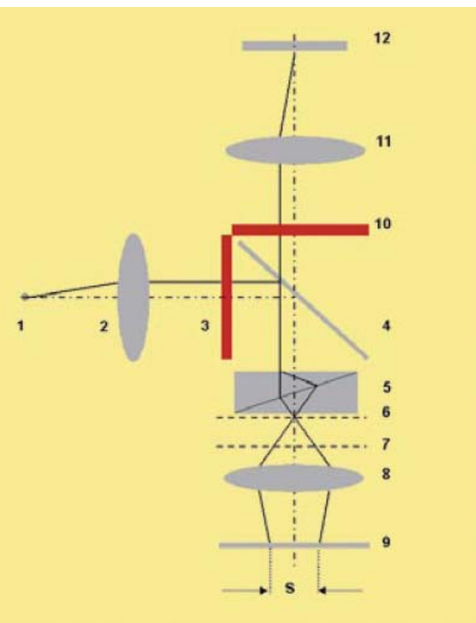
The light emitted from the light source (1) passes the collector (2) and is circularly polarized by the circular polarizer (3). The plane glass reflector (4) reflects the circular polarized light partly to the TIC prism (5). This results in a shear S in the object plane (9), which is far greater than the resolution limit (creation of a dual image split). The TIC prism (5) is dimensioned and arranged in such a way that the interference plane (6) does not coincide with the specimen exit pupil (7). This creates a dual pupil image and results in an interference fringe pattern.

After reflection on the object, the two images, polarized at 90° with respect to each other, pass the lens (8) again, are reunited by the TIC prism (5) and pass the circular analyzer (10). The resulting visible interference pattern is imaged through the tube lens (11) into the detector plane (12).

Contrary to traditional polarization interferometers, work is carried out in circular polarized light and not in linear polarized light. This enables rotation of the TIC prism without alteration of the contrast of the interference pattern. There is no longer any need for stage rotation, which was necessary in conventional techniques, and specimen cohesion remains. This is of particular advantage for the imaging and measurement of specimen structures found in various directions and for the analysis of samples with large areas.

- **Uncomplicated, cost-effective analysis of thin-layer samples**
- **Measurement of layer heights ranging from several micrometers through to the nanometer range**
- **Optimum resolution**





We make it visible.

TIC Measurement

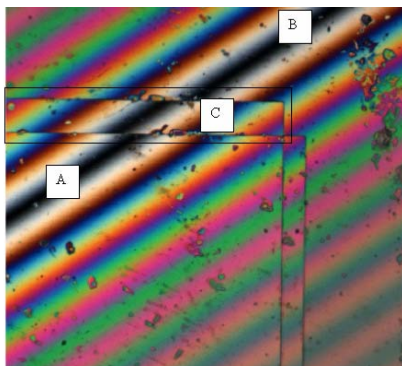
Enhanced AxioVision Functionality

The TIC module is integrated into AxioVision directly as an application, therefore expanding its functionality to include the measurement of the heights of thin layers. A workflow enables the user to carry out the measurement in one continuous sequence: from scaling and image acquisition through to TIC measurement and archiving of the measured image.

TIC Measurement

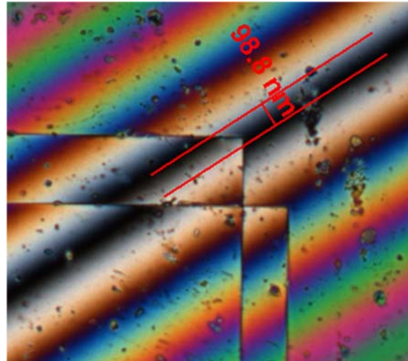
The principle of layer-height measurement is based on the measurement of the material-dependent displacement of the interference pattern.
The following image of a thin-layer sample illustrates the measurement process. Three flat regions are marked in the interference image:

- **A**: top left-hand corner of structure of unknown height
- **B**: underlying surface
- **C**: region with displaced interference fringes



Interference image with 3 regions, from which the layer height can be determined.

The height of the structure is determined by measuring the fringe displacement in C in relation to the position of the fringe in A or B. To do this, the user clicks at the center of the dark zero-order interference fringe in regions A and C or B and C. The measured value is displayed directly in the image. Measured images can be stored and managed in an archive.



Interference image with measured value for layer height.

Additional functions are also available in addition to TIC measurement.
Calibration: the measurement of layer heights requires special calibration.
Phase shift correction: if the layer and substrate consist of different materials, the material-dependent phase shifts need to be taken into account.
Correction of objective aperture: to apply the technique in practice, correction for finite illumination apertures is required.

Advantages of TIC Measurement

During the development and production of new layer systems (e.g. in the fields of semiconductor, medical and solar technology), suitable analysis techniques need to be employed to examine the specific properties of the samples.
The conventional techniques (such as X-ray diffractometry (XRD), transmission electron microscopy (TEM), energy-dispersive X-ray analysis (EDX) and Rutherford backscattering spectroscopy (RBS)) are extremely time-consuming and cost-intensive. An interference-based method for measuring layer heights is the Michelson interferometer. However, this type of measurement is extremely sensitive to vibrations. The advantage offered by the TIC interference fringe method is that it makes it possible to perform absolutely vibration-free (and therefore rapid) analyses with a high degree of measurement accuracy.
TIC microscopy in combination with the AxioVision TIC module offers you the examination of sample morphology and the non-contact measurement of the heights of thin layers in one easy-to-use system. Object structures ranging from a few nanometers through to several micrometers can therefore be measured.

System Configuration

- Reflected light microscope with EC objectives
- C-DIC reflector module for reflected light
- 6x20 TIC slider
- AxioCam digital camera
- Image Analysis Mini Workstation FireWire multilingual or Image Analysis XEON Workstation 2.8 GHz multilingual
- AxioVision software
- AxioVision module: TIC
- Alternative system configuration possible

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48-0068 e 04.2006