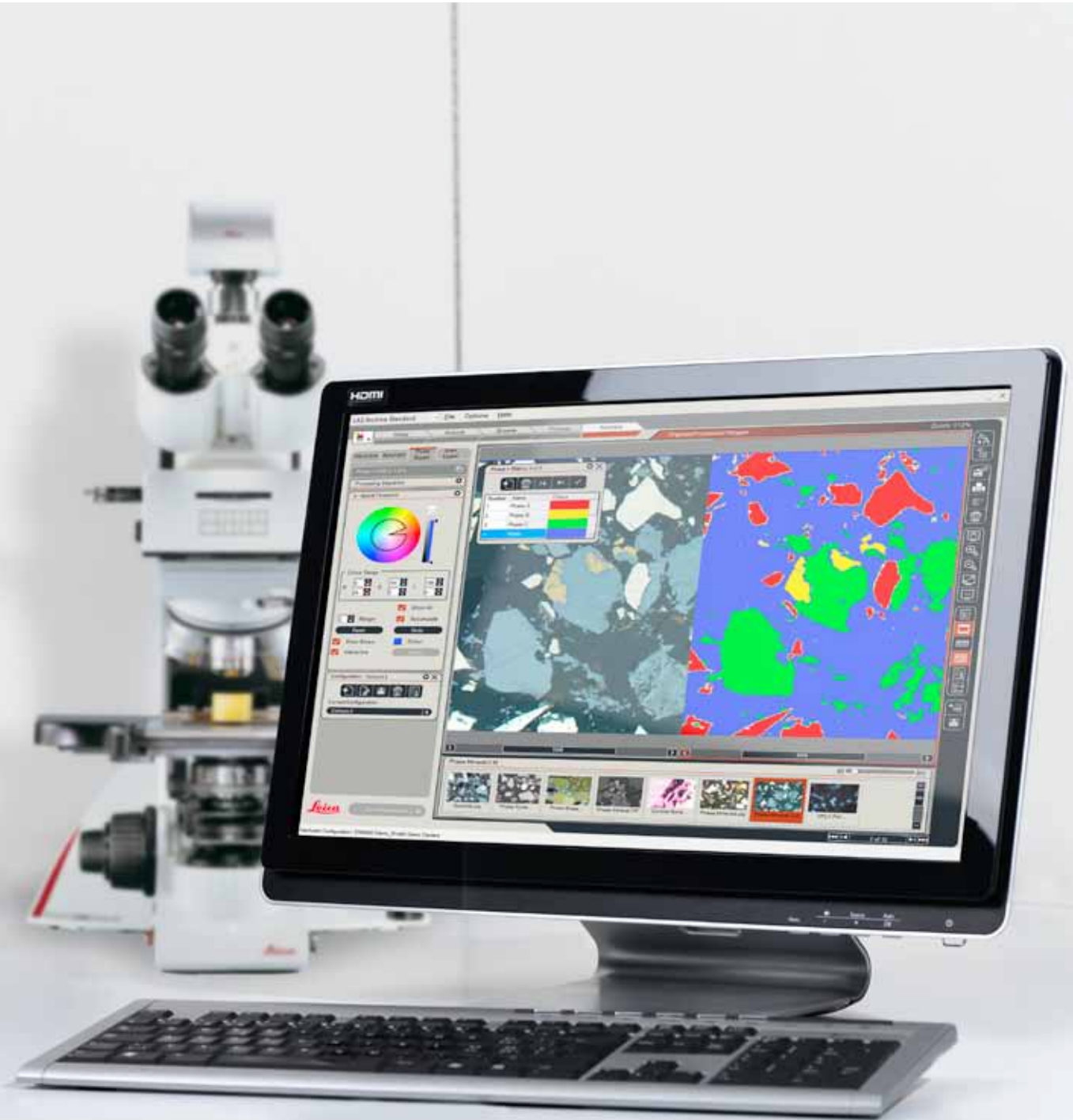Living up to Life

Leica

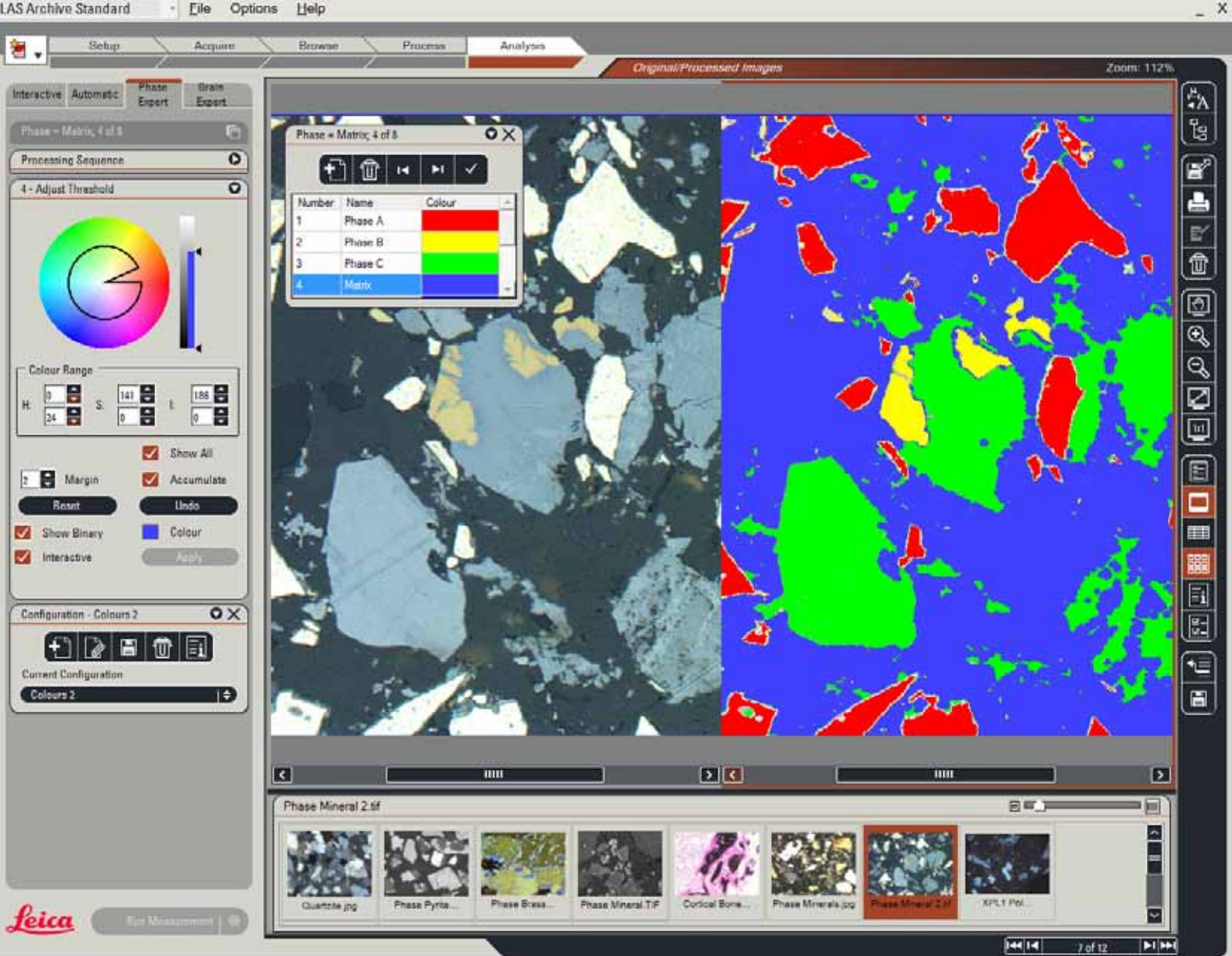**MICROSYSTEMS**

Leica Phase Expert

Smart Software for Analysis of Multi-Phase Microstructures

PHASE ANALYSIS TECHNIQUES

Leica Phase Expert automatically and precisely measures the area percentage of multiple phases within a sample or specimen. Phases are identified by grey level contrast or by regions of homogeneous color that can be defined by the user. Up to 10 phases can be differentiated by colored overlays and can be simultaneously displayed for the same field of view. Identification and measurement of multiple phases of an image can be performed within seconds. Results can be accumulated over multiple fields of view to allow statistically accurate characterization of the specimen.

Additional mode is provided that allows the definition of one of the phases as a 'reference phase'. The measurements of all phases are expressed as a percentage of this reference phase. This is useful for example where a background matrix has to be subtracted from the results. State of the art image processing is used to automatically enhance phases while the operator can always modify and confirm these by using the binary editing tool.

Results from the analysis are may be used to qualify material to specifications determined between purchaser and manufacturer, for identification of variations in manufacturing processes, or to provide data for research studies of the structure and property of materials.

Automatic, Objective and Repeatable

Leica Phase Expert application software performs automatic, objective, and repeatable measurement of multi-phase microstructures indicated by distinctive color or contrast. For example, reflectivity of components in oil-shale; polarization colors of constituents in a rock thin section for modal analysis; stain specific to tissue of a bone slide. Phase Expert can determine and quantify the occurrence of these phases with reference to the overall image or to just one of the selected phases.

Leica Phase Expert evaluates high-quality images provided by the Leica Application Suite. LAS intelligently integrates the latest advances in automated microscopy, computing and digital image analysis. With a wide range of applications designed specifically for materials and metallurgy laboratories it performs routine, yet sophisticated analytical tasks rapidly, efficiently, and economically.

This common micro-imaging environment is used to provide solutions to many industry standard materials applications such as grain, steel, phase, and cleanliness analysis. These applications integrate the understanding of specialists in the field into 'expert' applications dedicated to these tasks.
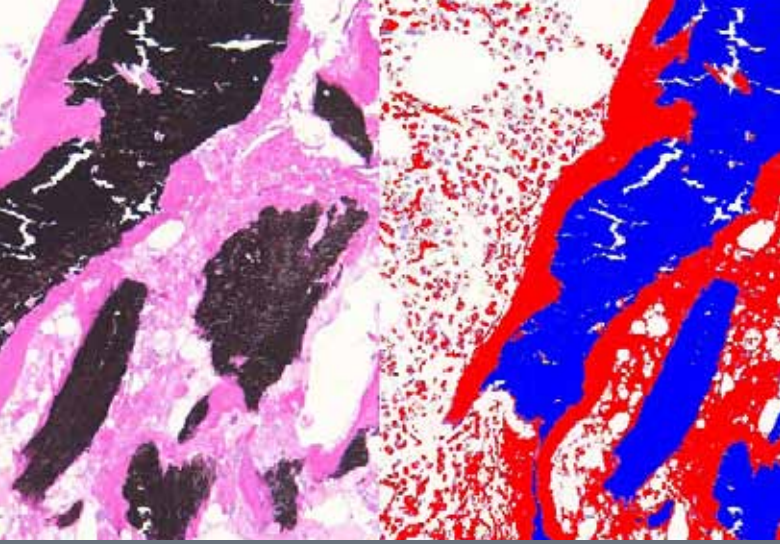
Different Phases in a metallic sample
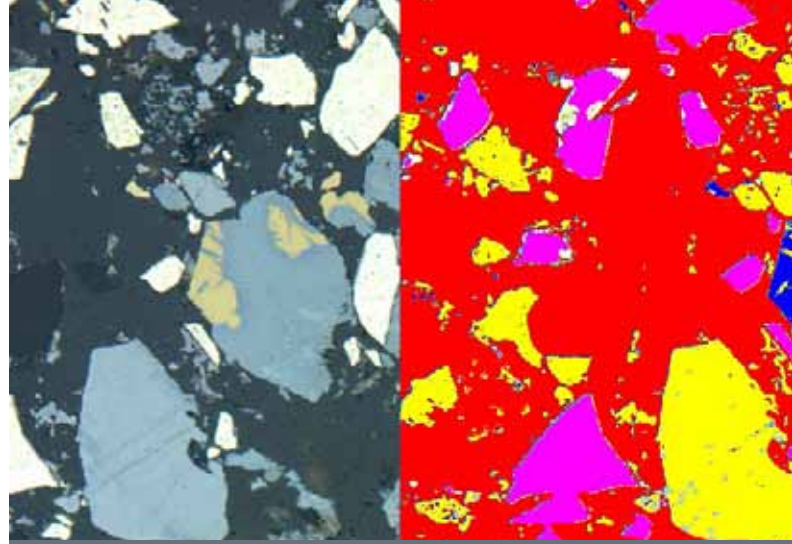
Different Phases in a metallic sample

Benefits and Advantages

LAS is designed to increase laboratory productivity and improve the accuracy of analysis by automating and imitating many of the manual processes required for materials analysis. As the analysis is objective, the results are inherently more reproducible.

TOTALLY INTEGRATED SOLUTION

With the combination of Leica Micro-systems microscopes, microscope cameras, image analysis expertise and automation, you benefit from a truly integrated solution from one manu-facturer.

VERSATILE REPORTING

Report templates can be configured to laboratory requirements using Microsoft® Excel™. Results are stored along with images, which allows all elements of the data to be recalled for detailed analysis. All your data is always available and traceable.

ENHANCED IMAGES

Phases are identified by color or contrast and image pre-filtering techniques can be applied to prepare the images for measurement. The versatile and high-performance image processing optimizes the phase detection to achieve reliable results rapidly.

COMFORT FOR THE OPERATOR

LAS is simple to use due to a unified method of image acquisition, calibration and peripheral control. Image analysis reduces the tedium associated with manual measurements while providing improved statistical results.

STEP-BY-STEP OPERATION

Obtain reproducible results by automati-cally controlling imaging conditions with automated microscopes and cameras in combination with your predefined image processing settings.

CONFIDENCE IN CONFORMITY

Leica Phase Expert software performs calculations that derive measurement parameters from digital images that can be used with appropriate standards. *

*The accuracy of the measurements and the compliance of the entire system to these standards strongly depends on a) the optical, electronic, and mechanical components used, b) the working conditions and sample preparation process, and c) the individual and specific interpretation of the results produced. These are the responsibility of the user of the equipment and Leica Microsystems disclaims any liability in that context.

The Nine Steps

Leica Phase Expert measurements are defined by the number of phases to be analysed and the Processing Sequence is repeated for all these phases. The number of phases or structures is selected and a name for each is entered. The color is used to show this phase as an overlay to the specimen image. The reference phase is chosen if required. Initially, the 9 steps of the Processing Sequence wizard are used interactively to establish the analysis parameters on typical specimens.
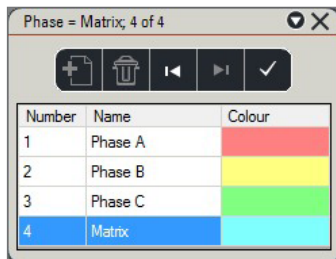

Once the parameters are established, they are saved to a named configuration file. This can then be applied to multiple sets of specimen images to ensure that repeatable and reproducible analysis is performed.

1. SELECT IMAGES TO MEASURE

Numerous specimen images can be processed in rapid succession simply by selecting their thumbnail in the Gallery and adding them to the Sequence image list.
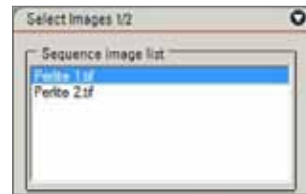
2. MEASURE FRAME

The Measure Frame defines the region of the image that is measured. It can be the whole field or a user defined region of the image.

3. IMAGE PROCESSING PRE-FILTER

The Image Pre-Filter step is used to improve image fidelity in preparation for selecting the phases such as to remove noise or other artefacts. The filter is applied before the phase is identified. Various filters are provided for example for smoothing, sharpening, background removal delineation.

4. ADJUST THRESHOLD

Thresholds are used to define the range of pixels values that define a phase. For a monochrome image, the colors of the phases are displayed on the grey level histogram.
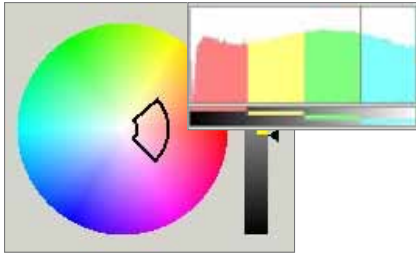
Color images are represented by the HSI color model and the hue, saturation and intensity ranges of pixels can be used to defines a phase.
In both the monochrome and color case, the thresholds are simply set by selecting the phase to be identified and clicking on representative pixels of the phase in the image. The pixels within the range are displayed in the selected color as an overlay on top of the specimen image. The overlay can be toggled on/off so that its correspondence with the specimen image can be checked. Several examples of these overlays are shown in this brochure.

5. BINARY PROCESSING PRE-FILTER

The Binary Pre-Filter step is used if the phase overlays need to be modified to make them more suitable for measurement. For example small holes can be filled in, noise can be removed. The filter chosen can be of a different type for each phase.

6. BINARY IMAGE EDITING

Binary Image Editing provides a collection of tools that allow the user to modify directly Binary Images to add, remove, select and de-select parts of the phase binary images. Facilities also include drawing and filling shapes as well as accepting and rejecting parts of the image.

7. RESULTS AND HISTOGRAM

The results are displayed in tabular form for each image and summary statistics are derived. The distribution of the area percent of individual fields can be displayed graphically as a histogram, bar chart or pie charts. This comprehensive detail is invaluable when close study of the materials is required.
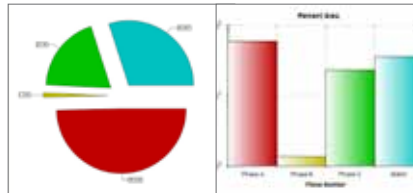
8. REFERENCE DATA

User and analysis references data can be added and customized to make the results totally product and company specific. The data entered is automatically transferred to the report.

9. CREATE REPORT

Reports are created using a Microsoft Excel template. A standard template is supplied with Grain Expert and this can be customized to fit into the needs of the organization. In addition to the overview data shown in the example, the entire detailed analysis results are stored in the spreadsheet for further evaluation.
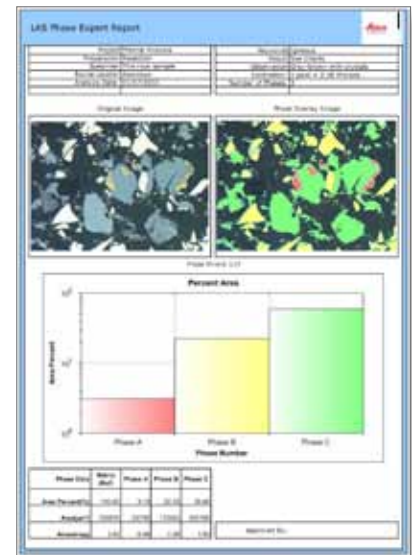
Image Acquisition Using LAS

Software and Microscopes talking together

The operation of Leica Phase Expert to give precise results assumes that the sample chosen is a good representation of the specimen being analysed and has been prepared in a manner that optimizes the clarity of the phases.

The first stage of phase analysis is to acquire a selection of digital images using LAS and to save these to the computer's hard drive. The advantage of this approach is that you always have the original images available if you wish to check your results later or to measure them again using a different standard.

› LAS calibrates the microscope and camera to ensure accurate definition of the image size.
› The imaging conditions such as microscope settings and camera exposure are automatically recorded when using automated microscopes. The data is stored with the image and can be used to exactly reproduce the imaging conditions of a particular analysis.
› Images are named and acquired in to a Windows folder from where they can easily be located.

› Images can be annotated with a calibrated scale bar customized to your requirements and labelled with time, date, image name and descriptions.
› Optionally capture images at pre-defined XY positions using a motorized stage, which ensures no bias in region selection.
› Optional recall of microscope and cameras settings from an existing image, which ensures the imaging conditions match previous settings.

Microstructures in false color
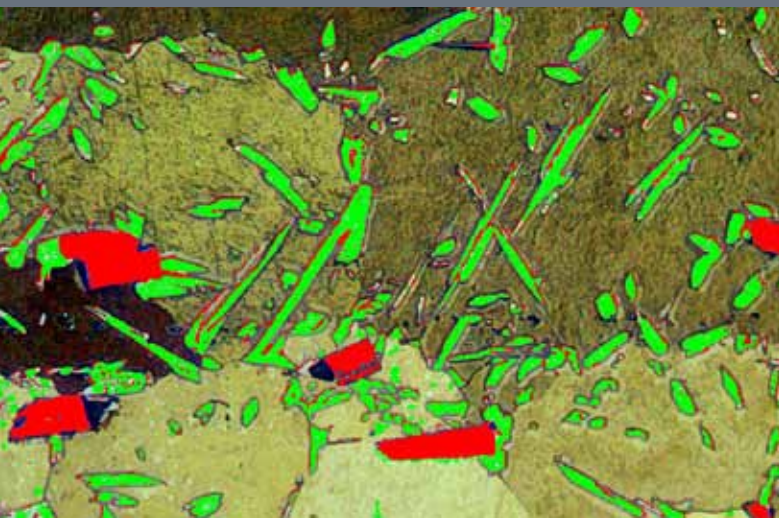
Different Phases in a metallic sample
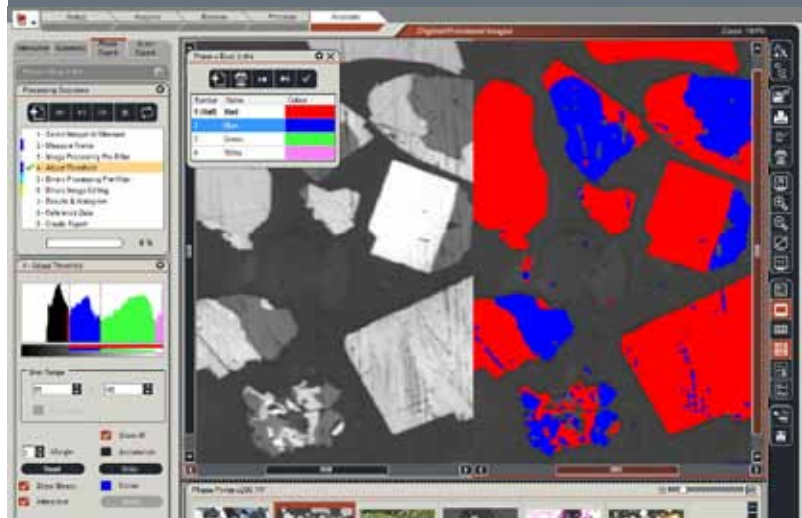
Leica Phase Expert Features

AUTOMATICALLY IDENTIFY SIMILAR REGIONS

› Phase identification can be based on monochrome continuous or disjointed thresholds for each phase.

› Phase identification can be based on HSI color thresholds for each phase.

› The system automatically recognizes from the image type, whether monochrome or true color detection is required.

› The phase identification is nearly instantaneously shown as an overlay over the original image.

› One phase can be defined as a reference phase for measuring phase percentages relative to the reference.

› The number and names of the phases can be defined.

ADAPT TO DIFFERENT PHASE SPECIMENS

› Enables multiple samples to be measured quickly and consistently.

› The image can be pre- processed to reduce image noise or to sharpen edges so that the phases can be easily separated.

› Interactive phase editing is performed by drawing lines using the mouse.

› Binary editing is individually made for the different phases click.

DOCUMENTATION OF RESULTS

› All standard measurement parameters of the individual phases are available for users who want to perform further analysis of the microstructure.

› The area percentages are displayed in the histogram with the same colors as the selected overlay colors.

› The phase overlays are colored according to their binary index color in the histogram.

› Statistics are available for multiple field measurements.

› All raw measurement data and selected images can be exported into a Microsoft Excel template.

› The template can be customized to meet local documentation standards.

› Exported data includes the reference data, all raw data, as well as all grain measurement and field data.

Table of Phase Parameters

MEASUREMENTS FROM THE PHASES

Phase Area (µm²) . . . . .The total area of the phase within the Measure Frame

Phase Area Fraction. . . . . .Phase Area / Measure Frame Area or Phase Area / Reference Phase Area

Phase Area Percent (%). . . . . .100× Area Fraction

Phase Area Fill. . . . . .The ratio of the area of interest to the area of everything else

Perimeter (µm). . . . . .The total length of the phase boundary within the Measure Frame

Mean Chord (µm). . . . . .The average horizontal chord. It is defined as the ratio of the measured field
area to the Horizontal Intercept.

Horizontal Intercept (µm). . . . . .Sum of intersections of all horizontal lines with the trailing edge of phase detail
that occur in the Measure Frame

Vertical Intercept (µm). . . . . .Sum of intersections of all vertical lines with the trailing edge of phase detail
that occur in the Measure Frame

Anisotropy . . . . .Describes the orientation of the phase, a dimensionless measurement defined
as the ratio between horizontal and vertical intercept

Count. . . . . .The number of isolated features ending within the Measure Frame

Count per unit Area (µm⁻²) . . . . .Count per Measure Frame Area

Absolute Specific Surface . . . . .Derived parameter of total area per unit volume.

Relative Specific Surface . . . . .Derived parameter of total area per unit volume of reference phase

Measured area . . . . .Measured field size defined by measurement frame

STATISTICS FOR BOTH TYPES OF MEASUREMENTS

Total

Mean

Standard Deviation

Standard Error

Maximum

Minimum

2-S Range

95% Confidence Interval

Relative Accuracy

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RELATED PRODUCTS

LEICA DM2500 M

The efficient Leica DM2500 M microscope for materials analysis and quality control.

LEICA DMI3000 M

The Leica DMI3000 M inverted, manual microscope for materials science, industrial quality inspection and assurance, and new materials research and development.

LEICA DM6000 M

The universal microscope for all common incident light methods (brightfield, darkfield, polarization, interference contrast, fluorescence contrast).

LEICA DFC450

The Leica DFC450 microscope camera contains a high quality 5 Mpixel CCD sensor for sharp, brilliant images for documentation and analysis in life science, clinical and industry applications.

The statement by Ernst Leitz in 1907, "with the user, for the user," describes the fruitful collaboration with end users and driving force of innovation at Leica Microsystems. We have developed five brand values to live up to this tradition: Pioneering, High-end Quality, Team Spirit, Dedication to Science, and Continuous Improvement. For us, living up to these values means: Living up to Life.

INDUSTRY DIVISION

The Leica Microsystems Industry Division's focus is to support customers' pursuit of the highest quality end result. Leica Microsystems provide the best and most innovative imaging systems to see, measure, and analyze the microstructures in routine and research industrial applications, materials science, quality control, forensic science investigation, and educational applications.

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Denmark · Ballerup	+45	4454 0101	4454 0111
France · Nanterre Cedex	+33	811 000 664	1 56 05 23 23
Germany · Wetzlar	+49	64 41 29 40 00	64 41 29 41 55
Italy · Milan	+39	02 574 861	02 574 03392
Japan · Tokyo	+81	3 5421 2800	3 5421 2896
Korea · Seoul	+82	2 514 65 43	2 514 65 48
Netherlands · Rijswijk	+31	70 4132 100	70 4132 109
People's Rep. of China · Hong Kong	+852	2564 6699	2564 4163
· Shanghai	+86	21 6387 6606	21 6387 6698
Portugal · Lisbon	+351	21 388 9112	21 385 4668
Singapore	+65	6779 7823	6773 0628
Spain · Barcelona	+34	93 494 95 30	93 494 95 32
Sweden · Kista	+46	8 625 45 45	8 625 45 10
Switzerland · Heerbrugg	+41	71 726 34 34	71 726 34 44
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