AUTOMATED DIGITAL 3D TOPOGRAPHY MEASUREMENT WITH THE LEICA DCM 3D
DUAL CORE MEASURING MICROSCOPE

Ing. Jan MATĚÁSKO

MIKRO, spol. r.o., Dolnokrčská 54, 140 00 Praha 4, mateasko@mikro.cz

Abstract
The precise measurement of surface structures and topography is the key thing during the production, control and development in many sectors of industry or research. Because very often there is not possible to use some contact methods for performing this task new optical methods based on interferometry and confocal technology started to be available for non-contact surface metrology in the recent years. The Leica DCM 3D dual core measuring system introduces the unique machine which combines the advantages of both – confocal and interferometry. Now we have in our hands a very useful and flexible tool for super fast, precise and non-destructive assessment of the micro- and nano-geometries of critical material surfaces.

Keywords: confocal microscopy, interferometry, non-contact measurement, 3D topography, surface measurement, nanotechnology, material assessment

Introduction
In the modern science dealing with the different fields of present research you can find very frequent and sometimes not so simple task to investigate, reconstruct, measure and document all possible information regarding to the structure and topography of your sample’s surfaces. When you look to the steel industry, mechanical engineering, metal-processing, metal-producing, automotive industry, glass, ceramic manufactures, research institutes etc. Everywhere you can find many applications where the investigation of surface parameters plays very important role for the process control, quality control, damage analysis and it is very useful during the development of new materials as well.

1. THE CONTACT AND NON-CONTACT MEASUREMENT OF SURFACES
Because the measurement of surface topography is not often able to do with the help of contact methods, interferometers and optical imaging profilers based on the confocal technology started to appear very frequently in the recent years. A lot of companies produce their measuring machines with the using of first or second mentioned approach separately but there exists the one machine which combines both interferometry and confocal measuring techniques to the one powerful system. We are speaking about the 3D Dual-Core measuring microscope Leica DCM 3D!

1.1 Leica DCM 3D dual core measuring microscope
As mentioned Leica Microsystems has developed the new complete solution for their customers who need to investigate and assess the quality of surfaces of their metal, plastic, glass etc. samples. Thanks to the combination of confocal and interferometry Leica DCM 3D is able to measure the surface parameters in the wide range from several millimeters to tenth of nanometers. It means that this machine is very flexible and it can be used for measurement and 3D reconstruction of quite rough but really very flat surfaces too. With this single system it is possible to analyze rough (confocal) as well as smooth
(Vertical Scanning Interferometry or VSI) and super smooth (Phase Shift Interferometry or PSI) surfaces in the easy way.

1.2 THE UNIQUE FEATURES OF LEICA DCM 3D
For the best results Leica DCM 3D uses the special Leica objectives which cover the magnification range from 5x up to 150x and these objectives are equipped with the higher numerical apertures 0.15 – 0.95 for the confocal mode of surface analysis. With the using of these confocal objectives Leica DCM 3D is able to measure from moderate smooth to rough surfaces with the highest repeatability and more than 70° of local slope. For the interferometry techniques and sub-nanometer vertical resolution during the measurement of the smoothest surfaces the special interferometry objectives with the magnifications 5x – 50x are available. With the using of these objectives Leica DCM 3D is able to achieve the highest lateral resolution of 150 nm and a vertical resolution of 0.1 nm in PSI mode!

Against the conventional confocal microscopes which use movable mechanic parts inside a scanning heads (usually scanning mirrors or spinning discs) that limit the instrument’s lifetime, need a periodic re-adjustment to maintain optimum performance and introduce mechanical vibrations that increase noise on the measurement Leica DCM 3D uses advanced microdisplay technology! It is a fast switching device with no moving parts inside that makes the scanning of confocal or interferometry images fast and stable with an extensive lifetime. With the help of this technology Leica DCM 3D is able to scan and acquire the complete image with the creation of precise 3D model from 3 to 10 second time interval.

The Leica DCM 3D is designed to be maintenance-free. Instead of typical expensive lasers two high-power LEDs are integrated into the beam path, which provides a long average lifetime of 20 000 hours. A white LED is used for color brightfield inspection, confocal images with real color texture, and VSI. A blue LED is used for high-resolution confocal imaging and PSI. The blue LED’s short wavelength increases lateral resolution to 0.15 µm and improves PSI noise to 0.1 nm of vertical resolution.

Leica DCM 3D uses two integrated camera systems for the fast and quality image acquisition. At first there is one high-resolution monochromatic CCD camera which delivers black and white images at high speed and it works like a metrology image sensor. The second one is colored CCD camera which is optimized to capture the real texture of the sample with the highest color accuracy and contrast.

The important part of the whole system is the software for control of all functions of the microscope and for the measurement of individual 2D and 3D surface parameters. You can measure roughness, areas, volumes, lengths, highs etc. You can get statistical data, pseudo color maps, depth maps, profile images etc. You can create your own reports which can be designed according to your requirements exactly.

2. APPLICATION EXAMPLES
Leica DCM 3D is successfully used for example during the testing of adhesion ability on a steel surface, where the micro-valleys are created with an acid attack. This enables the paint to penetrate further into the surface and increasing the effective contact area. The next nice application is using of Leica DCM 3D for measurement and characterization of solar cells. There are usually monocrystalline or polycrystalline silicon layers used for the covering of solar panels and the regularity together with right structure of silicon material are very important for complete efficiency the whole solar panel or power station. Leica DCM 3D helps to control and measure the most important surface parameters and became an indispensable tool for the quality and processed control in these cases. The possibilities of using are really wide. Leica DCM 3D can be used for non-contact roughness measurement, inspection of color, coating, consistency, fungal attacks and many others applications.
CONCLUSION
At these days we could say that we are at the beginning of so called nanotechnology age. Everything becomes smaller. We try to produce smaller mobile phones, i-phones, tablet PC etc. We need smaller electronic chips but with the same or better power, we need thinner material layers with the higher efficiency, we need to control our materials and products under the higher zooms. The micro- and nano-structures of our products are more and more important for us. We must be able to inspect more and more details from our world. We need such tools like confocal and interferometry microscope Leica DCM 3D for our future life!