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Head of the laboratory

The experts

Roman Major PhD, Eng.
r.major@imim.pl

Przemysław Kurtyka, MSc. Eng.
Maciej Szlezynger, MSc. Eng.
Justyna Więcek, MSc. Eng

Address:

Institute of Metallurgy and Materials Science Polish Academy of Sciences

ul. Reymont 25, 30-059 Krakow

phone: **(48) 12 295 28 98**, fax: **(48) 12 295 28 04**

e-mail: zlb@imim.pl, website: http://www.imim.pl

Apparatus:

Confocal Laser Skaning Microscopy LSM Exciter 5 with the incubation chamber

- Confokal Modul LSM 5 Exciter, two canals, RGB
- Laser HeNe 633nm 5mW
- Laser HeNe 543nm 1mW
- Laser argon 458/488/514nm, 25mW
- Diode laser V 405nm
- Main Beam Splitter turret PASCAL
- Software ZEN 2008 LSM 5 EXCITER
- Light division system (405, 458, 488, 514, 543 nm)
- Filter BP 505-530
- Filter BP 505-600
- Filter BP 530-600
- Filter BP 560-615
- Filter LP 420
- Filter BP 420-480
- System ECU LSM 5 EXCITER
- Modul DIC I/0,9 z polaryzatorem
- Transmited light detectorT-PMT LSM 710
- Heating stage
- Incubation system


LSM 5 EXCITER
Imager.M1

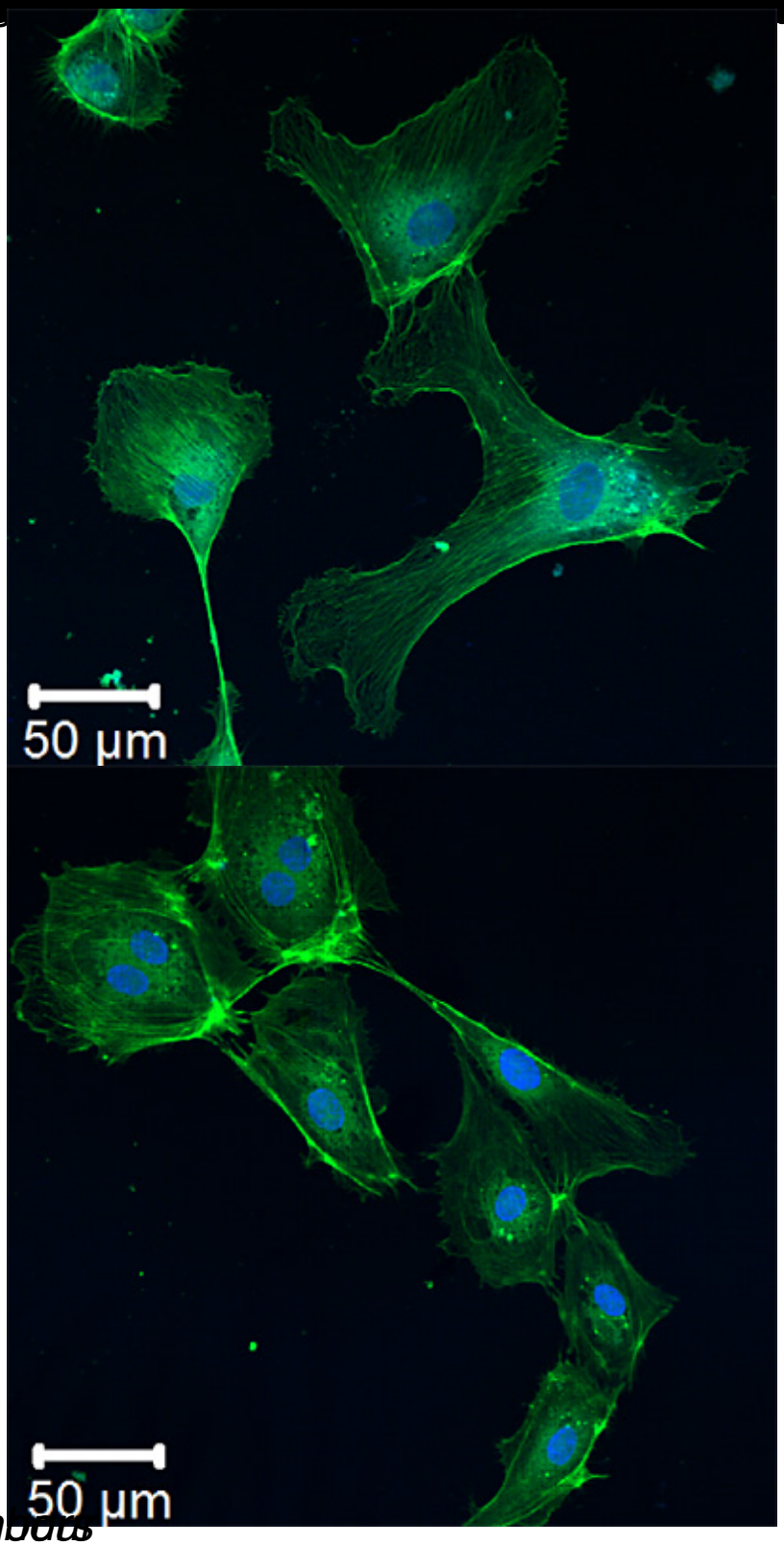

Figure 2a After 24 hours

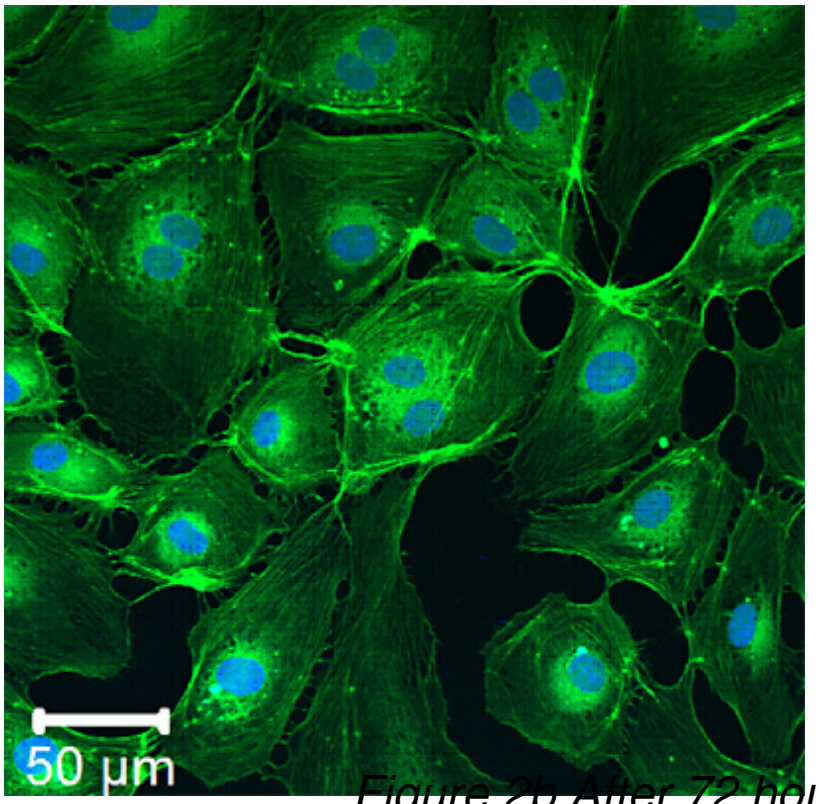

Figure 2b After 72 hours

Scanning Acoustic Microscopy SAM

The acoustic microscope works in the pulse reflection method. The most important component in the scanning acoustic microscopy is a high frequency piezoelectric sound transducer. This object transmits and receives sound pulses of high penetration rate. It is a sapphire cylinder with a ZnO film (1). A transducer generates a ultrasound pulse (piezoceramic layer converts electromagnetic vibrations into sound wave) which propagates along the delay rod. The transducer is immersed within a coupling medium (water). The immersion system cavity is therefore the acoustic spherical lens. A lens focuses beam within the sample. The acoustic objective receives the sound reflections from the sample. The information follows to the return to transducer. There transforms them into

electromagnetic pulses detected by an oscilloscope and on the monitor display them as a pixel. The acoustic objective scans the sample line by line. Figure 3 shows a scheme of an acoustic microscope system.

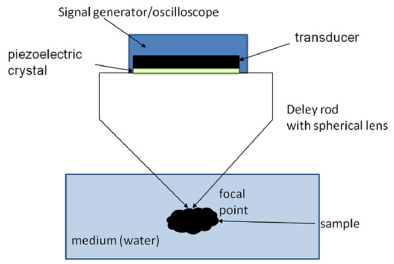

Figure 3. Scheme of the Scanning Acoustic Microscope

The result of the SAM is determined by aperture and acoustic wavelength, which is depends on the material but this microscope can detected damage to a minimum size of 0,3 μm. Depending on the critical defect size and defect depth the working frequency and transducer design have to be chosen. The important information is that the SAM works in real time mode. The scanning acoustic microscope is equipped with a 4 heads (15MHz, 75MHz, 110MHz, 180MHz).
The Scanning Acoustic Microscope works on several modes (Figure 4). A 2D scan gives information about x-y plane and 3D scan image provides information about x-y plane and the time of flight the acoustic beam. The most popular are scan A, scan B, scan C and scan X. Scan A mode is used to characterize a

single point of interest in a specimen. The B-scan mode generates a top-down or X-Z axis image. The C-scan is a compilation of A-scan but not in one point but along X-Y axis, they a display of the image of reflected echoes at the focused plane of sample. Scan X is used to view image at a depth of the sample.

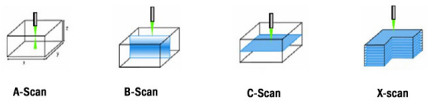

Figure 4. Scan mode in Scanning Acoustic Microscope

Example

Having described the principles of the scanning acoustic microscope is now presented same results. The scanning acoustic microscopy is being used to analyse: bonded and

soldered structures, castings, interface and semiconductor components, material stress and crack propagation, interface evaluations of thin coatings, biological, geological and ceramics structures, detection of delaminations in packages, 3-dimensional imaging of welding, determining volume defects .

One of the applications of the scanning acoustic microscopy was in the study of bio-ceramics mater. In Figure 5 is presented an acoustic image of hydroxyapatite sintered at various temperatures. This material is characterized by inhomogeneous and different pores sizes.

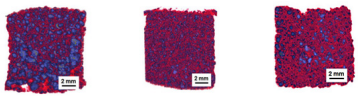

Figure 5. Visualization of micropores or inhomogeneous material (hydroxyapatite) using the SAM

The SAM is a good techniques to detect small defects in the surface and under the surface. Using this technique it is possible to find cracks smaller than 1 μm. Surface near cracks, delaminations, void or inclusions due to their different elastic

properties from the surrounding materials. In figure 6 is presented an acoustic identification of the defects within the massive forging ingot. The SAM identification of defects at difference depth from the surface. In the figure 6 are visible defects (holes), contains a carbon stalagmite (yellow arrow indicates the carbide localized inside the void) and some porosity. In figure 7 is presented a deeper layer in this material (forging ingot).

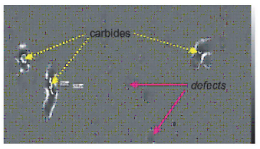

Figure 6. Visualization of carbides localized inside the void and common defects (porosity) in ingot

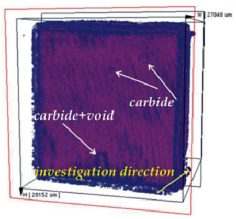

Figure 7. Image to the sample forging ingot applying the method "layer by layer" from the surface registered by the SAM

Contact for the Client:

Head of the Lab L-7:
Roman Major, PhD, D.Sc.
phone: **+48 12 295 28 41/05**
e-mail: **r.major@imim.pl**

PCA Zak

Laboratorium Laserowej i Akustycznej Mikroskopii Skaningowej L-7 ul. Reymonta 25; 30-059 Kraków		
Przedmiot badań/wyrób	**Rodzaj działalności/ badane cechy/metoda**	**Dokume**
Obiekty i materiały biologiczne Biomateriały, metale i stopy metali, polimery [E]	Morfologia obiektów Fluorescencyjnych Metoda: mikroskopii konfokalnej	P/19/IB-16
Materiały lite o powierzchni płaskiej, kompozyty, połączenia spawane, podzespoły elektroniczne [E]	Struktura wewnętrzna materiałów, defekty powierzchniowe i topografia powierzchni, niejednorodność struktury w obszarze przypowierzchniowym Wielkość obszaru Zakres: (1 – 300) mm Skaningowa mikroskopia akustyczna (SAM)	P/19/IB-17

E – Elastyczny zakres akredytacji. Elastyczność zakresu obejmuje elementy wskazane w dokumencie DA-1 laboratoriów badawczych.

Lista działań prowadzonych w ramach elastycznego zakresu akredytacji jest udostępniana publicznie lub na akredytowany podmiot.

Laboratorium formułuje opinie i interpretacje w sprawozdaniach z badań podanych w powyższej tabeli.