NEWSLETTER AUTUMN 2021

We are excited to introduce you to a first issue of a newly-launched **Czech-BioImaging quarterly Newsletter Autumn 2021**. The newsletter will serve as another informational channel to bring news about the infrastructure activities to our users.

Czech-BioImaging is a national research infrastructure for biological and medical imaging. It is a distributed infrastructure of leading imaging facilities in the Czech Republic. The infrastructure provides an open access to a wide range of imaging technologies and expertise to all scientists in the Czech Republic and from abroad by a unified and coordinated logistics approach.

Among regular sections of the newsletter, you will be able to find: a) new technologies column from a selected Czech-BioImaging facility, b) most important Czech-BioImaging user results, c) upcoming and past events organized by Czech-BioImaging

FOCUS ON TECHNOLOGIES

EDS - ENERGY-DISPERSIVE X-RAY SPECTROSCOPY

EDS is a method enabling us to determine elemental composition of samples with spatial resolution of a TEM. Basic principle revolves around detecting and measuring energy of X-rays radiated by the sample while illuminated by the electron beam inside the TEM.

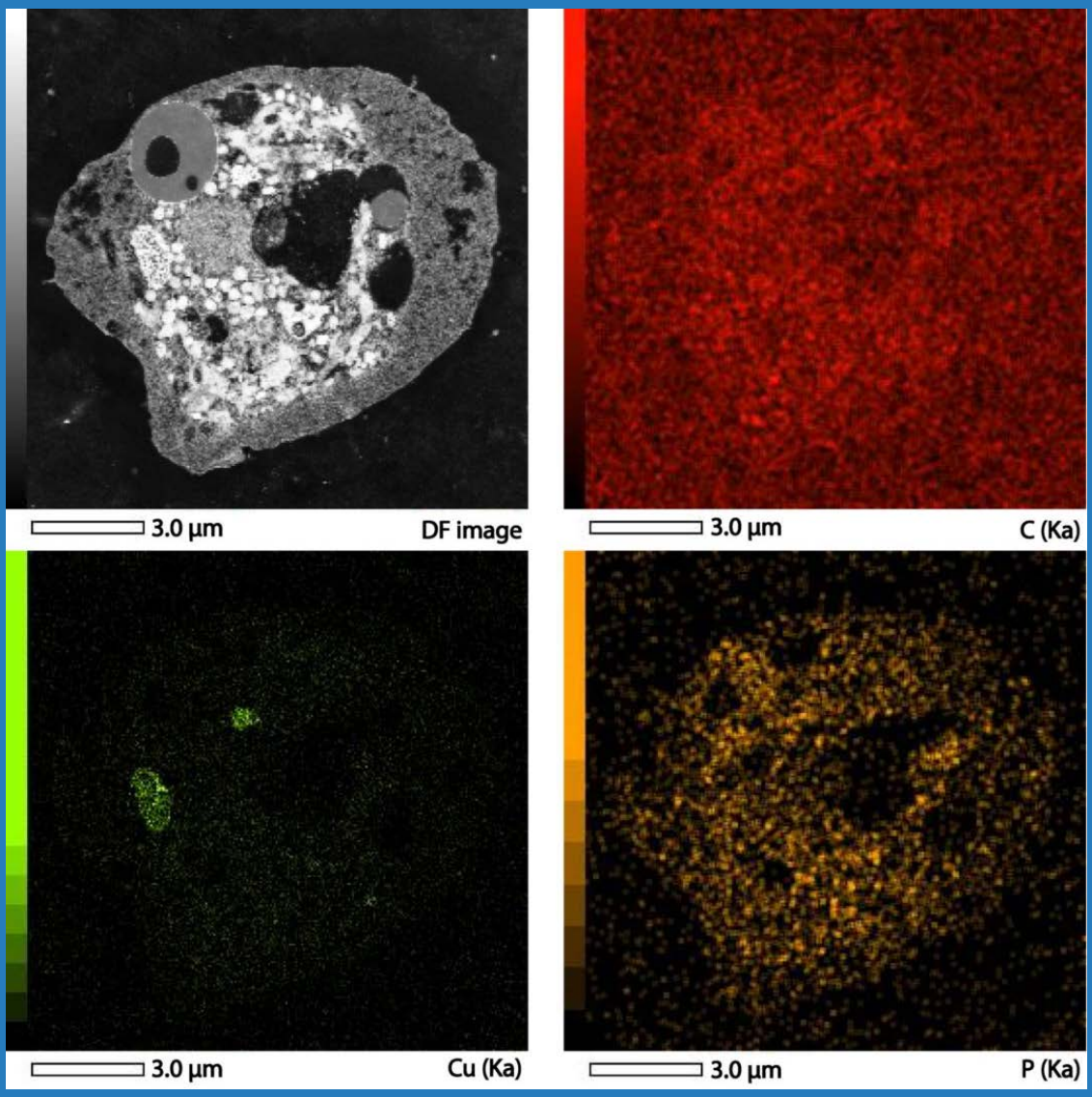
Each element has a specific fingerprint of energies and by carefully analyzing the measured spectra, we can determine presence and relative abundance of certain elements. It is possible to either integrate the whole region of interest, focus on a point or to acquire an image map, retaining separate information for each pixel. Suitable samples are similar to general TEM samples – most often thin section of resin embedded material or dispersion of particles on support

film. The sample has to be able to tolerate a considerable dose of electrons as especially acquisition of maps can take many hours of continuous illumination to produce meaningful results. Expected sensitivity for detecting an element is around 0.1% of total content with exceptions varying in both directions depending on multiple factors.

Not all elements are equally easy to detect and measure. Basic biogenic elements such as carbon, nitrogen and oxygen are easily detected and discriminated. On the other hand, iron is difficult using our current setup, as the internal structure of the instrument contains iron that produces a strong signal potentially obscuring any weaker signal originating from the sample. Also, some elemental peaks overlap with those of another element making specific combinations incompatible, such as detecting phosphorus when osmium is used for contrasting. Special consideration has to be payed to support grid and sample holder used. As for sample holder, we use low background beryllium holder that produces only one peak with very low energy that doesn't interfere with detection of other elements. Sample grids are available in many different forms and materials and it is necessary to consider if it's composition (such as copper or gold) doesn't directly interfere with elements of interest or if there isn't spectral overlap.

As an example of results acquired at our facility, image shown depicts a cell exposed to copper nanoparticles. Top left DF image is a high-angle annular darkfield STEM image of the cell and each image marked with an element sign shows a map of said element distribution. Most notably bottom left map proved that observed aggregates were indeed composed of copper from nanoparticles in Pacheco et al. "Understanding the toxicity mechanism of CuO nanoparticles: the intracellular view of exposed earthworm cells." Environmental Science: Nano (2021).

If your scientific projects would benefit from nanometer-scale information about elemental composition, do not hesitate to contact us in the **Electron microscopy core facility of the Institute of Molecular Genetics** for a discussion on the best approach to your specific scientific question.



Darkfield image (top left) and EDS elemental maps of a cell exposed to copper nanoparticles. Data acquired on Jeol JEM-F200 operated at 200 kV in STEM mode. Total integration time was 600 seconds. ("Understanding the toxicity mechanism of CuO nanoparticles: the intracellular view of exposed earthworm cells." Environmental Science: Nano 2021)

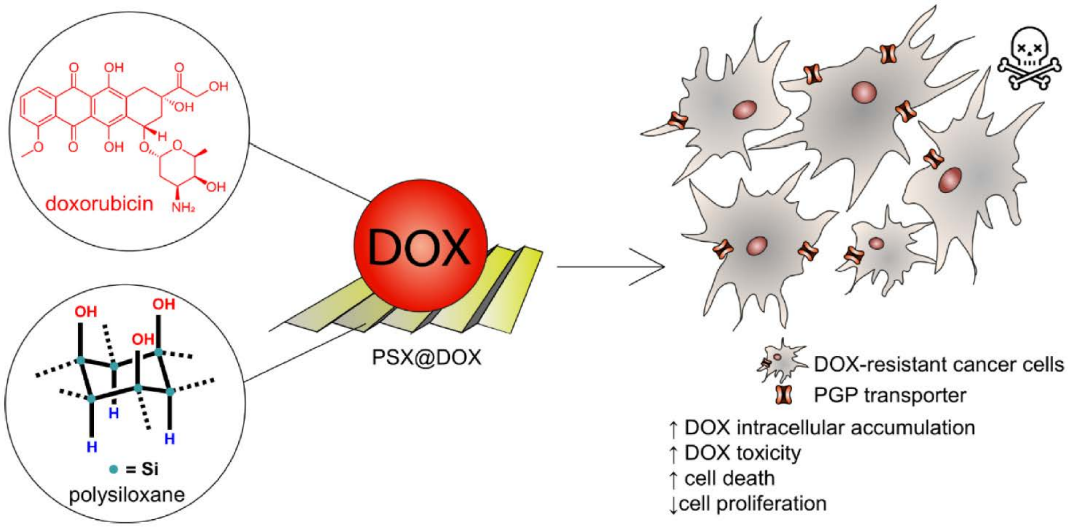
HIGHLIGHTS OF USER RESULTS

STRATEGY FOR ENHANCEMENT OF THERAPEUTIC EFFICIENCY OF ANTICANCER COMPOUNDS USING A NOVEL NANOMATERIAL – RNDR. MICHAELA FOJTŮ, PH.D.

The aim of our **study**[1] was to design a strategy enhancing the therapeutic efficiency of anticancer compounds using a novel nanomaterial derived from silicane. Our silicane derivative belongs to the group of 2D nanomaterials and was prepared by team led by prof. Zdeněk Sofer from UCT Prague. 2D nanomaterials attract nowadays a great attention.

Their name refers to the reduced third dimension resulting in a large surface area that can be decorated with various types of molecules. They are routinely utilized in the field of optoelectronic, or construction of devices for energy storage and detection of pollutants in the environment. After proving material non-toxicity and biocompatibility, we investigated its potential application in biomedicine. We explored applicability of silicane derivative in the field of targeted drug delivery and treatment of malignant diseases by loading its surface with doxorubicin, one of the most widely prescribed cytostatics in the clinical practice. Thanks to Dr. Ešner and his team from the **Cellular Imaging Core Facility (CELLIM) at CEITEC MU** in Brno we acquired data that helped us to prove enhanced accumulation of doxorubicin using our nanomaterial. Consequently, the drug can have longer and more stable therapeutic effect. Laser scanning microscope LSM 880 with AiryscanFast module was used for this analysis. Doxorubicin-resistant ovarian carcinoma cell line was used as it should have very low sensitivity to doxorubicin therapeutic effect. The resistance is caused by higher expression of P-glycoprotein in membrane of these cells. P-glycoprotein is an efflux transporter expressed physiologically and its function is to pump toxins and xenobiotics out of the cells. Nevertheless, its higher expression results in the development of multidrug resistance leading to an increased cellular removal of drugs applied prior they can exhibit their therapeutic effect. Higher cellular accumulation of doxorubicin was achieved by loading it on a surface of our novel silicane derivative. Using an in vivo model with doxorubicin-resistant tumor we further proved 3.5-fold reduction of tumor size in the comparison with the free form of drug.

1. **Silicane Derivative Increases Doxorubicin Efficacy in an Ovarian Carcinoma Mouse Model: Fighting Drug Resistance**
Michaela Fojtů, Jan Balvan, Tomáš Vičar, Hana Holcová Polanská, Barbora Peltanová, Stanislava Matějková, Martina Raudenská, Jiří Šturala, Paula Mayorga-Burrezo, Michal Masařík, and Martin Pumera
ACS Applied Materials & Interfaces **2021** *13* (27), 31355-31370
DOI: 10.1021/acsami.0c20458



Principle of the drug delivery strategy using PSX NS in drug-resistant cancer cells.[1]

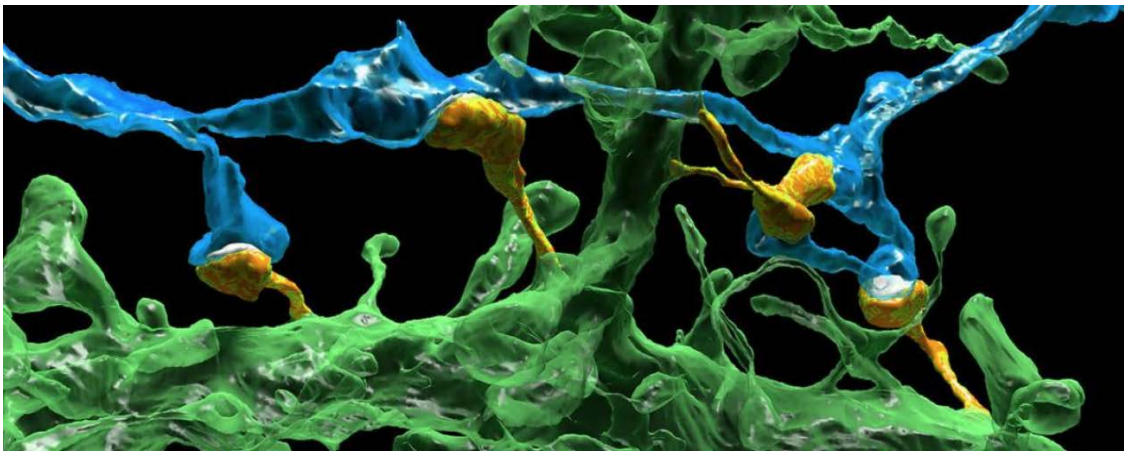
PAST & UPCOMING EVENTS

IMAGING PRINCIPLES OF LIFE 2021

After a very challenging year of almost exclusively virtual gatherings, an annual Czech-BioImaging scientific conference 2021 took place on October 26 – 27 in OREA Resort Devět skal in Vysočina.

The conference was dedicated primarily to the Czech-BioImaging users and scientists interested in biological and medical imaging. During four sessions dedicated to fields of electron microscopy, light microscopy and medical imaging, there were **25 high-quality scientific talks**, all of which were appraised by the **audience of nearly 100**. Two talks of industrial sector representatives and a Euro-BioImaging manager Johanna Bischof were introduced as well. Advances in the quality of the used techniques in the presented research projects were significant, which was reflected in the number of questions following each presentation. An important part of the conference was undoubtedly the poster session consisting of around **20 scientific posters** on display in a next-door seminar room. The conference also gave space to **6 commercial exhibitors** to introduce their newest microscopic equipment and offer services to the researchers. We are hoping to repeat the notable success of the event at *Imaging principles of life 2022*, preliminarily scheduled to early October 2022. Stay tuned. More info soon on our website **czech-bioimaging.cz.**

UPCOMING EDUCATIONAL ACTIVITIES



3D-CLEM IMAGING FUNCTION AND ULTRASTRUCTURE

Practical course | November 22 - 25, 2021 | UK, BIOCEV, Vestec, Czechia

Practical hands-on training on 3D correlative light and electron microscopy combining confocal fluorescence imaging and electron microscopy imaging contain focused ion beam milling (FIB-SEM) and electron tomography (ET).

MICROSCOPY METHODS IN BIOMEDICINE

Practical Course | 22nd – 26th November 2021 | IMG, Prague, Czechia

The five-day theoretical course with practical demonstrations is devoted to modern light and electron microscopy, and the program is updated every year to reflect the newest trends. The course covers the theoretical background of microscopy as well as fundamental techniques in microscopy, and continues quickly to cutting-edge methods like super-resolution light microscopy, light-sheet microscopy, imaging of whole living organisms, and cryo-electron microscopy.

NEUROIMAGING – MAPPING THE FUNCTION AND STRUCTURE OF BRAIN

Hybrid form | November 23 - 25, 2021 | CEITEC, Brno, Czechia

The educational course focuses on processing and analysis of fMRI data. The course will cover following topics: Morphometric Methods and Their Reach to Functional Brain Mapping, Diffusion Imaging, Specifics of Animal MRI Studies, Processing and Analysis of Electrophysiological Data, and many more!

DIAGNOSTIC TOOLS FOR IMAGING ANIMAL MODELS

Practical course | December 1 | Institute of Physiology, CAS, Czechia

In vivo imaging of neuronal activity, in vivo imaging of brain blood perfusion, holographic endoscopy, animal models for in vivo imaging, future and visions

of animal microscopy, super-resolution microscopy of mitochondria and leucocytes.

USEFUL LINKS

Czech-bioimaging – pro veřejnost

Czech-bioimaging – technologies

Euro-BioImaging website

Velké výzkumné infrastruktury

The National Infrastructure for Biological and Medical Imaging, Czech-BioImaging, is supported by the Ministry of Education, Youth and Sports of the Czech Republic (project No. LM2018129) and by European Regional Development Fund (project No. CZ.02.1.01/0.0/0.0/18_046/0016045).

MINISTRY OF EDUCATION
YOUTH AND SPORTS

EUROPEAN UNION
European Structural and Investment Funds
Operational Programme Research,
Development and Education

---

www.czech-bioimaging.cz