Experts in femtosecond laser technology for biomedical applications

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JenLab wins *The New Economy Award 2014 for Best Medical Diagnostics Systems Company*

High-Resolution Laser Biopsies with Chemical Information may replace surgical biopsies

June 2014. **JENLAB** receives **The New Economy Award** in the new category *Best Medical Diagnostics Systems Company*. The German company receives this prestigious Award for its development of a high-resolution tissue imaging tomograph based on femtosecond lasers that has the potential to replace surgical biopsies.
The TNE-Awards 2013 were given e.g. to *SPACEX* founded by Paypal and Tesla founder *Elon Musk* for the first commercial paylot into space, *SAMSUNG* for its Galaxy Gear smart watch, *AIRBUS* for its A350ZWB plane, and *Amazon/CEO Jeff Bezos* for delivering packages with pilotless drones.
The full list of 2014 winners will be announced to the market in the Winter Issue of *The New Economy* for distribution at The World Economic Forum in Davos and to the global readership (100,000 copies).

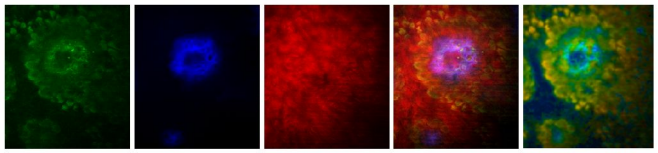
Prof. Karsten König, CEO of JenLab, explains the Award-winning medical diagnostic laser system

Every year millions of biopsies are taken in hospitals and ambulances around the world for diagnostic purposes. Typically, the patient will receive the diagnosis after several days to one week. This traditional method is costly, time-consuming, invasive and painful. It would be a revolutionary step in clinical diagnostics – specifically histopathology – if the tissue in question could be examined with the required high-resolution tomograph non-invasively: meaning without any surgical intervention. This painless examination should occur quickly within seconds or at the most minutes.
It would be ideal if these 'biopsies' could be obtained without any labelling while in their native microenvironment and with information on its chemical composition and physiology, such as its metabolic status. Such *in vivo* histology becomes a reality with the use of femtosecond laser-based multiphoton tomograph MPT*flex* CARS. These new clinical imaging tool can provide rapid, scar-free and label-free optical biopsies with chemical fingerprints and superior subcellular submicron resolution. In fact, multiphoton biopsies have at least 1,000 times better resolution than conventional ultrasound, X-ray or MRI images.

How to get laser biopsies

JenLab's multiphoton tomographs are the first certified medical femtosecond laser diagnostic tools. The novel tomographs provide a rapid microsopic view into the skin and other tissues by fast scanning tightly focused near infrared beams with 80 million laser pulses per second. The mean laser power is equivalent to that of a laser pointer. The beams excite intrinsic biomolecules to emit fluorescence as well as other weak signals that can be detected with single photon sensitivity. During scanning, high-contrast images of the intratissue architecture appear immediately on the screen of a monitor. The patient can watch their cells, nuclei and organelles immediately on the screen. An optical tissue section takes only seconds: the patient and the doctor can monitor single cancer cells, inflammation sites, the migration of repair cells, the distribution of melanin pigments and even single elastin fibres and the collagen network. Chemical imaging is mainly achieved through a non-linear process called Coherent Anti-Stokes Raman Scattering (CARS), based on molecule vibrations such as with C-H bonds of lipids.

Early diagnosis of skin cancer and stem cell tracking



Besides imaging tissue morphologies and chemical decomposition, functional imaging is feasible due to the fact that biomolecules such as NAD(P)H are involved in cellular metabolism, acting as biosensors. The NAD(P)H level correlates with age. Reactive oxygen species – produced through means such as UV radiation – result in a decrease of NAD(P)H fluorescence, whereas antioxidants provided by healthy food or certain recent anti-ageing products increase autofluorescence (AF). The University of California employs JenLab's flexible tomograph to study skin physiology and oxygen consumption, while Procter & Gamble uses it to test the next generation of its Olay products, which increase NAD(P)H levels. A major application is the early diagnosis of skin cancer. Hospitals in Irvine, Brisbane, London, Modena, Nizhny Novgorod and Berlin are employing the recently developed tomograph to detect black skin cancer on a sub-cellular level. Scientists at the Charité in Berlin – the largest hospital in the European Union – perform *in vivo* CARS studies on cancer patients, as well as to detect intratissue chemotherapeutics that may cause hand-foot syndrome. Other dermatologists use the tomographs as personalised medical tools to optimise the treatment of dermatitis and actinic keratosis. The flexible tomograph has also been employed in San Diego at the AntiCancer company to explore potential cancer treatments based on engineered bacteria, as well as the completely non-invasive observation of stem cells within hair follicles.

Testing of Anti-Ageing Products

Major clients of JenLab include cosmetic companies. For the first time they can monitor the *in situ* accumulation of active compounds and carriers, as well as their interactions with skin components. Cosmetic research includes testing the biosafety of sunscreen nanoparticles, which should not penetrate deep to enter blood vessels, as well as to study anti-ageing effects such as the stimulated biosynthesis of collagen. JenLab's multi photon tomographs are able to define the skin age parameter SAAID by measuring the ratio of elastin to collagen. The SAAID index of a young girl who smokes heavily or regularly visits tanning salons is similar to that of a middle-aged woman.

Laser Biopsies from Astronauts

One of JenLab's most exciting ongoing multiphoton studies is its collaboration with NASA and the European Space Agency (ESA) in evaluating skin ageing effects in astronauts who are working for a half year on the International Space Station (ISS). Skin problems such as dryness, rashes, itchiness, loss of elasticity, thinner skin and slow healing rate are the most commonly described negative impacts on astronauts' health during space flights. Besides the lack of gravity, astronauts face a significant amount of exposure to extraterrestrial radiation. Furthermore, bioparticles from their own skin tissue – as well as that from other crew members – can cause allergic skin reactions. The life span of a skin cell is approximately four weeks; meaning skin is renewed once a month – at least on Earth. Scientists involved with ESA-Project Skin B hope to answer the question of how astronauts' skin regeneration is affected. The skin will age faster than on Earth, but astronauts may develop more efficient cell regeneration and healing rates upon arriving back home. It is a good opportunity to study the use of skin protective agents containing antioxidants. Currently, astronauts provide multiphoton biopsies prior to launch and immediately post-flight. For future interplanetary travel, it will be necessary to measure the effects of cosmic rays, biocontamination and microgravity effects while on board. JenLab is working on a device for the next generation: a compact, easy - to use imaging device for applications both on earth and in space that can be used to monitor medical risks via optical tissue parameters. Their plan also includes testing this device at high-altitude mountain levels prior to going extraterrestrial. Shortly before the Berlin Wall came down, König escaped from East Germany via Siberia and Tibet to West Germany so as to realize his dream of conquering an 8,000 meter peak (www.thelastescape-film.com). udf-kk

More information

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About JenLab GmbH

JenLab, the expert in femtosecond laser technology in biomedicine, was founded in 1999 as a HighTech spin-off company of the University Jena. JenLab is technology provider in the field of clinical multiphoton tomography for skin cancer detection and *in vivo* intratissue drug screening as well as in the field of femtosecond laser nanoprocessing in Life Sciences. The company pioneered high resolution skin imaging using JenLab's certified femtosecond laser multiphoton tomographs and is so only provider of femtosecond laser transfection tools. Further products include laser scanning two-photon microscopes. Major customers include research hospitals in Europe, Asia, Australia, and US, the European Space Agency (ESA) as well as cosmetcial and pharmaceutical companies such as P&G, J&J, L'Oreal, Chanel, Beiersdorf, Kao, Shizeido, Alcon/Novartis. JenLab has facilities in Jena and Saarbruecken. www.jenlab.de

Prof. Karsten König

The biophysicist and cell biologist Karsten König is founder and CEO of *JenLab GmbH* and Full Professor at the *Saarland University* and director of the *Department of Biophotonics and Laser Technolgy* (BLT) (www.blt.uni-saarland.de). He wrote more than 200 peer-reviewed scientific publications, 30 book chapters, and 30 patents.

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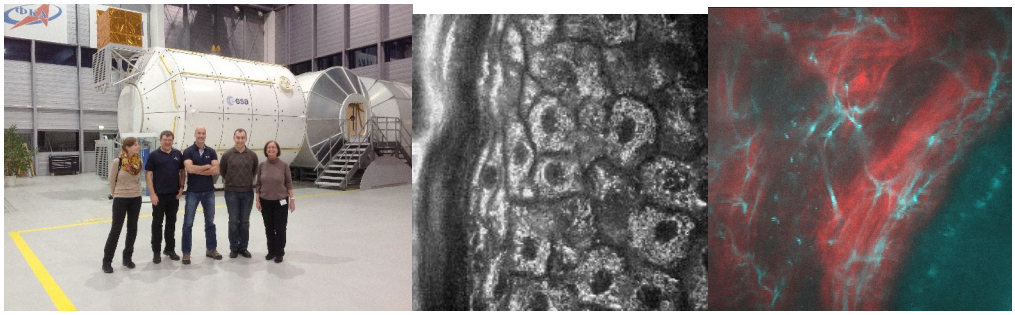

Left: SkinB-Team with astronaut Luca Parmitano at the European Space Agency, middle: single cells, right: elastin and collagen fibers deep into the skin