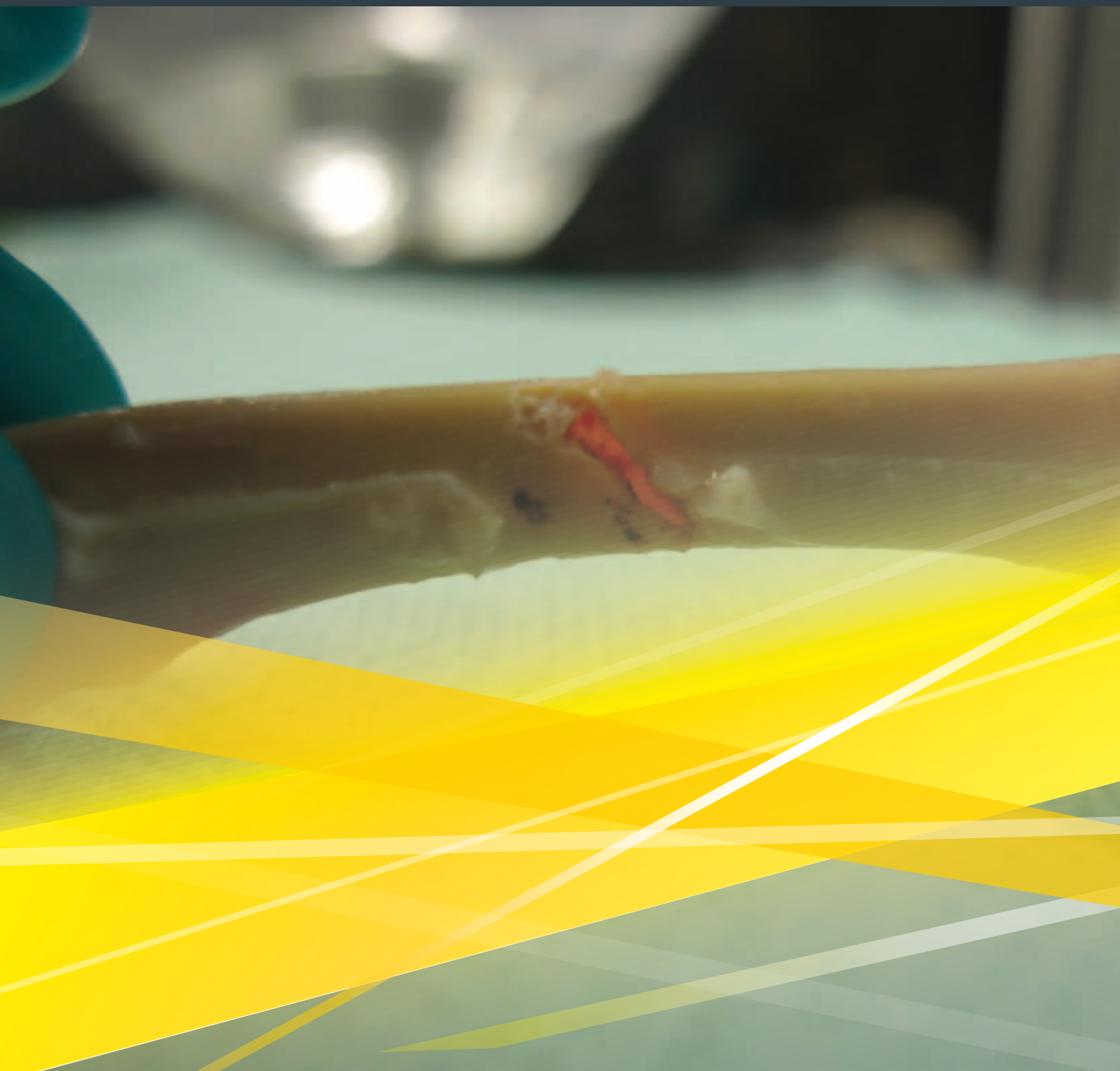
Medical Laser
Innovative Laser Systems

MEDICAL APPLICATIONS

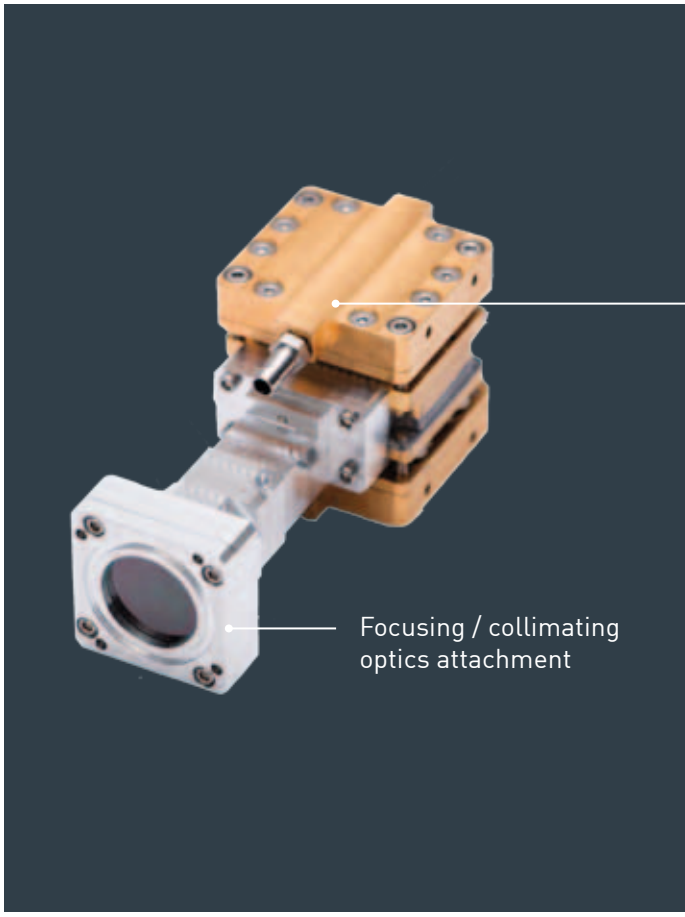


3m.i.k.r.o.n.™

High-power, diode-pumped laser technology

3m.i.k.r.o.n.™ is the technology platform for compact, efficient, fast and reliable lasers for a wide range of potential applications in the field of medical engineering. It enables a new generation of innovative mid-IR lasers based on diode-pumped solid-state technology, operating at wavelengths of 2 to 3 µm using different types of laser crystals (e.g. Er:YAG, Er:YLF, Tm:YAG).

Compared to mechanical tools, traditional laser technologies (e.g. flash lamp pumped Er:YAG or CTH laser) and RF technology (e.g. CO2 laser), 3m.i.k.r.o.n.™ offers several benefits within the particular field of application.



BENEFITS

. Combines benefits of traditional Er:YAG and CO2 lasers
. Reduced down-time period, faster healing
. Less invasive
. Easier to use
. Less heating of surrounding tissue
. Precise treatments (cutting width ‹ 100 µm)
. Controllable thermal impact by laser parameters
. Cold ablation (cut like a scalpel)
. Hot ablation (coagulation) by stacked pulses
. Selective ablation
. Maintains healthy tooth structure
. Minor lateral thermal damage
. No unwanted vibrations to the patient
. Short operation time
. Optimized for soft and hard tissue treatment

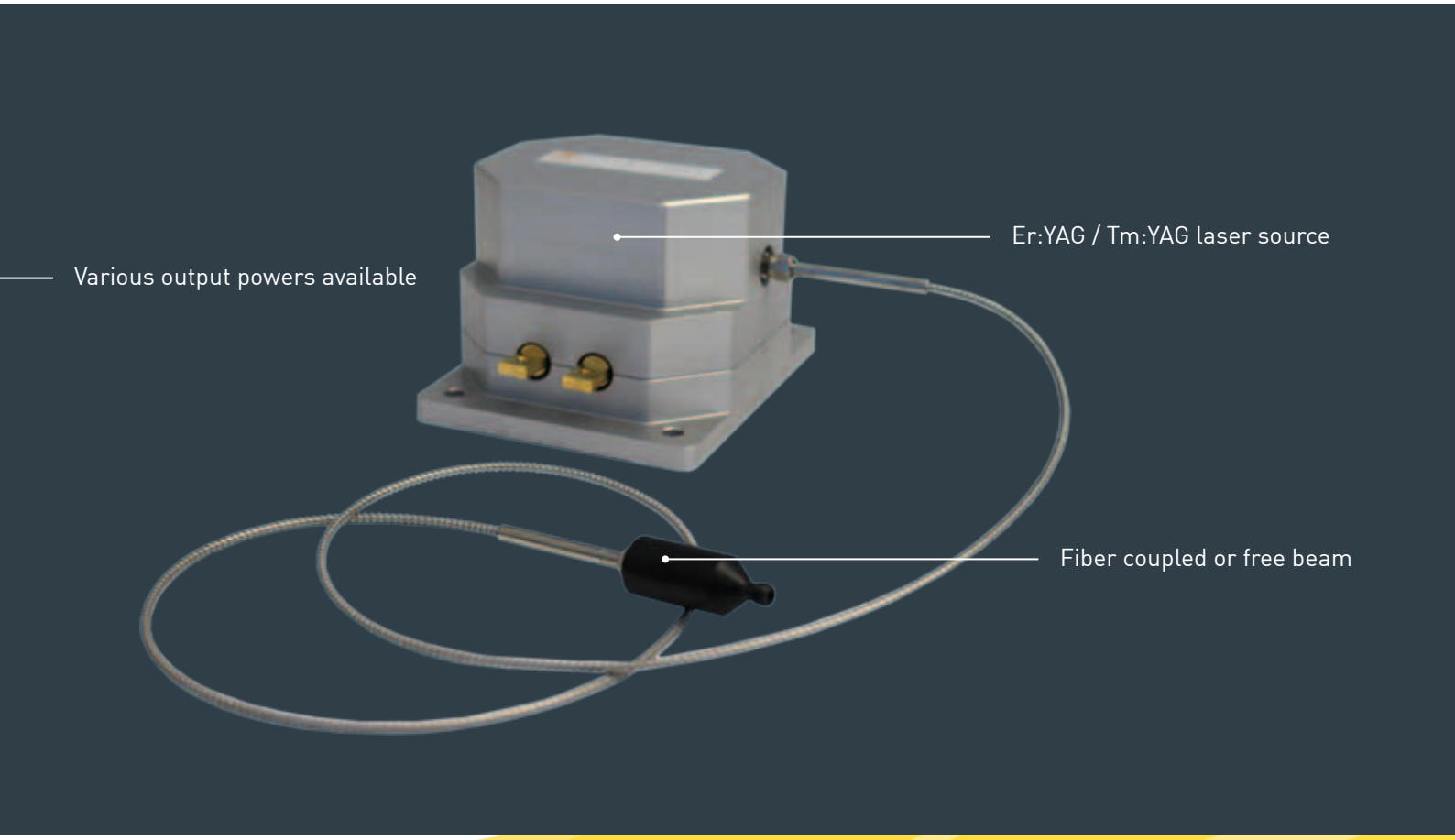
LASER PARAMETERS

High power Mid-IR laser sources

Technology	Monolithic DPSSL
Wavelength	2940 nm / 2020 nm
Average Output Power (max)	up to 100 W
Pulse Energy (max)	up to 8 J*
Pulse Repetition Rate	up to 2 kHz
Pulse Duration	up to 20 ms*
Duty Cycle (max)	up to 10 %
Mode of Operation	Pulsed
Ideal Fiber Diameter	100 - 450 µm
Beam Quality	M^2 ‹ 50
Efficiency (optical-optical)	~ 10 %
Divergence (half angle) (mrad)	‹ 50 mrad
Beam Diameter	1.6 mm
Beam Shape (focus)	top hat like

* @ 2020 nm with Pantec Superpulse Mode

All research experiments on the following pages were done with 3m.i.k.r.o.n.™ Er:YAG laser sources ranging from 20 to 30 W average output power.



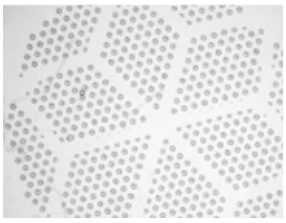
DERMATOLOGY

3mikron™ impresses with its high degree of flexibility. It enables cold ablation with high energy pulses and high thermal impact by heat stacking with a series of low energy pulses. A few high energy pulses can open the skin and drill into the target skin layer, dermis. Then a series of low energy pulses can heat the dermis for strong rejuvenation effect, which is comparable to the effect of a CO_2 laser. Furthermore, the repetition rate can be 2 kHz and allows therefore using a beam deflection unit for sequential pore drilling instead of using multi-lense arrays. This results in a homogeneous pore distribution, variable pore densities and very high energy respectively thermal impact per pore (25 times higher energy compared to traditional Er:YAG lasers with mulit-lense arrays).

Integration example of 3mikron™

Er:YAG fractional ablative laser
P.L.E.A.S.E.® Professional

Micropores generated with 100 ppp (in vivo). Slight coagulation, but no blood is visible.



Micropores generated on thermal paper. The grid results from a disposable, which keeps the skin in focus over the whole treatment area.

The P.L.E.A.S.E.® Professional is a portable fractional ablative laser system developed by Pantec Biosolutions. It combines the painless generation of micropores with a high thermal impact activating the production of collagen in the dermis with the generation of minimal pain.

The method is best described by the fact that only a fraction or a percentage of the skin is treated. The laser generates micropores surrounded by untreated intact tissue. Since there is only few necrotic tissue that has to be removed before wound repair, a very fast wound healing response takes place. Additionally, precisely controlled thermal effects produce a selective dermal damage within the respective target tissue layer which effectively stimulates fibroblasts to produce new collagen and elastin.

Now, the new P.L.E.A.S.E.® Professional represents remarkable technology innovations ensuring superior clinical results but greatly minimizing associated downtime as a result of advanced pulse shaping technology, controlled heat stacking, superior pore quality, and precise pore distribution.

OPHTHALMOLOGY

Starting in 2000 many experiments were performed regarding the usage of flashlamp pumped Er:YAG-lasers for ophthalmologic applications by different institutes and companies. The results clearly show, that contrary to ultrasound systems flashlamp pumped Er:YAG-laser can be used for cataract extraction (including precise capsulorhexis) as well as for vitrectomy.

Our new generation diode pumped Er:YAG laser based on the 3m.i.k.r.o.n.™ technology extends the advantages of the flashlamp pumped Er:YAG-laser while at the same time removing flashlamp laser's disadvantages because of its high efficiency, compactness and high repetition rates.

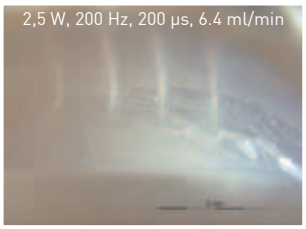
In the last few years several companies presented femtosecond laser systems, which are comparable to 3m.i.k.r.o.n.™ lasers as regards the clinical advantages for cataract extraction. However compared to 3m.i.k.r.o.n.™ femtosecond technology isn't recommendable for hard lenses and its costs are about 10 times higher.

Comparison of different technologies for ophthalmologic applications

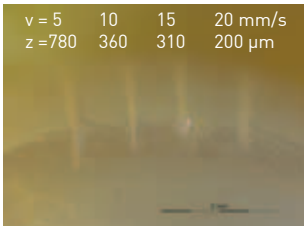
	3m.i.k.r.o.n.™ Phaco	Ultrasound Phaco	Flashlamp Phaco	Femtosecond Laser
Invasiveness	very good	medium	good	very good
Usability	very good	medium	good	medium
Hard lenses	very good	medium	very good	low
Heat	x/10	x	x/10	negligible
Speed	very good	very good	low	very good
Size	460 x 380 x 250 mm[1]	380 x 350 x 150 mm[2]	360 x 650 x 970 mm[2]	› flashlamp phaco[2]
Weight	12 kg[1]	15 kg[2]	85 kg[2]	› flashlamp phaco[2]
Repetition rate	up to 2 kHz	n.a.	up to 30 Hz[2]	up to 30 kHz[2]
Cost	x	x	x	10x

[1] P.L.E.A.S.E.® Professional device (intraepidermal drug delivery, dermatology & aesthetics); www.pantec-biosolutions.com.
[2] Typical device.
All specifications and ratings are assumptions based on literature.

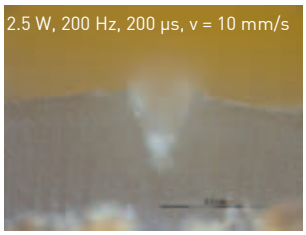
This work was done in cooperation with the Institut für Lasertechnologien in der Medizin und Messtechnik at the University of Ulm, Germany



Humid pork lenses, › 365 days in formalin



Humid pork lenses, › 365 days in formalin



Humid pork lenses
72h in formalin

Humid pork lenses
24h in formalin

DENTISTRY

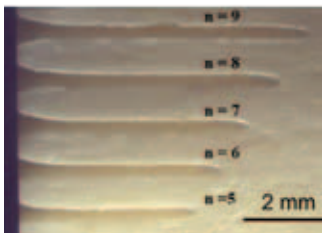
Treatment of soft and hard dental tissue

- Perfect for replacement of flashlamp pumped lasers
- Design of small and convenient lasers systems possible
- Faster healing and minor thermal damage
- Ideal for soft and hard tissue treatments
- Multifunctional laser tool for dental and maxillofacial surgery / applications

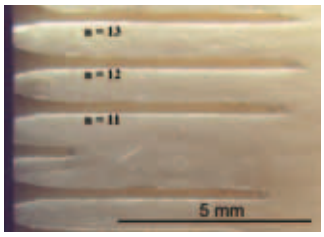
No more dentophobia, painless treatments, no mechanical drilling, less injections and narcotics, maintains healthy tooth structure

RESULTS

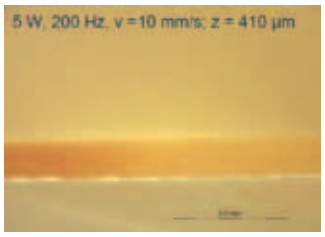
- Smooth and homogeneous cuts on the cut border (in case of the fiber tip)
- High cutting depth › 6 mm
- Thermal impact controllable by laser parameters and cutting speed



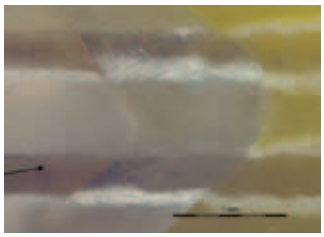
Bone ablation

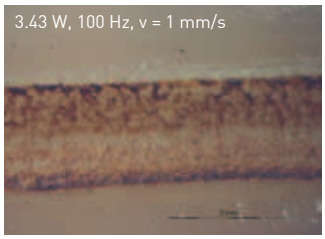


Bone ablation

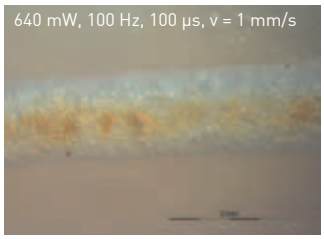


Tooth (Dentin), with waterspray

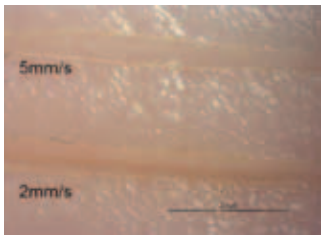

Tooth (Enamel), with waterspray



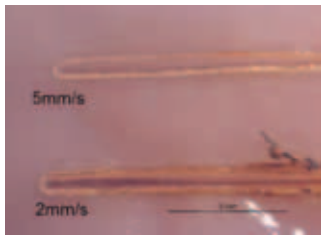
Soft tissue, Coagulation



Soft tissue, Coagulation



Porcine mucosa
2.17 W, 300 Hz, 250 µs



Porcine mucosa
1.4 W, 300 Hz, 250 µs

In cooperation with Institut für Lasertechnologien in der Medizin und Messtechnik at the University of Ulm (Germany)

MINIMALLY-INVASIVE SURGERY

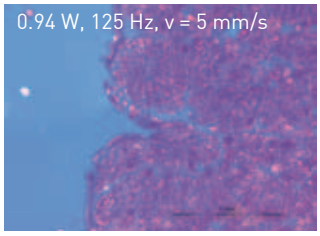
Treatment of soft tissue

RESULTS

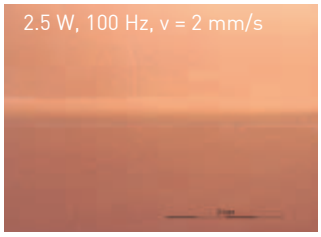
- Constant speed and power, but higher repetition rate at lower pulse energy leads to lower depth of cut and more thermal impact
- Cuts with very high quality
- Thermal impact (cold / hot ablation) and depth of cuts (10 µm to 6 mm) is controllable by laser parameters and cutting speed

Cold ablation

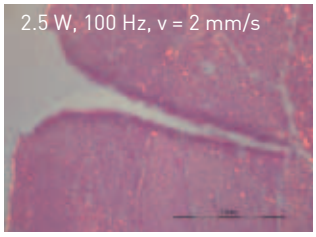
Chicken breast, Treatment without waterspray



Histology, Chicken breast, Treatment without waterspray



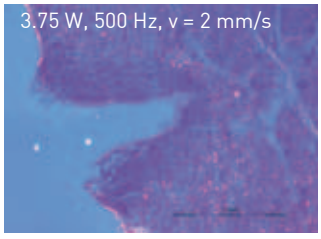
Chicken breast, Treatment without waterspray



Histology, Chicken breast, Treatment without waterspray

Coagulation

Chicken breast, Treatment without waterspray



Histology, Chicken breast, Treatment without waterspray

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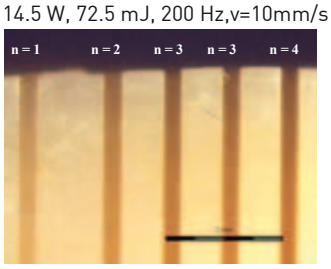
MINIMALLY-INVASIVE SURGERY

Treatment of hard tissue

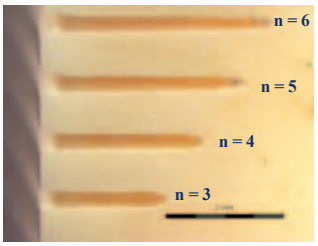
RESULTS

- Good ablation quality (smooth groove walls, sharp edges, no carbonization)
- High cutting depth: › 6mm
- High ablation / drilling speed: e.g. 34.4 mm/s
- High ablation efficiency: e.g. 0.141 mm^3/J

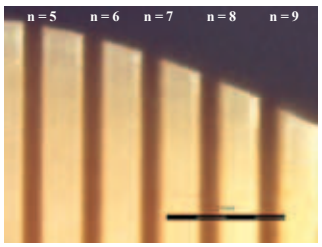
14.5 W, 72.5 mJ, 200 Hz,v=10mm/s



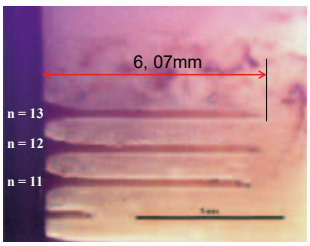
Bone, Treatment with waterspray



Bone, Treatment with waterspray



Bone, Treatment with waterspray



Bone, Treatment with water-spray

Our services

- Laser development and system integration from prototyping to complete devices
- Customized laser sources
- Optical and mechnical design
- Contract development and manufacturing
- Medical device consulting (IP, Medical CE, ..)

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