BREAKING THE PULSED KW RANGE –
NEW TRENDS FOR LASER-BASED MANUFACTURING USING EXCELLENCE ADVANCED PHOTON SOURCE

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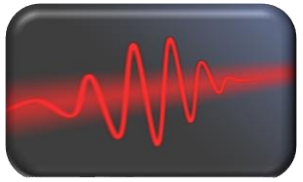
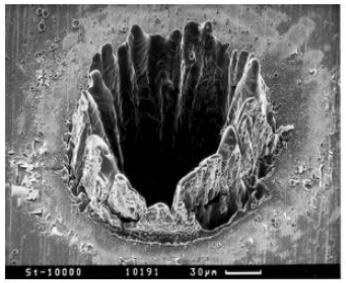
The vision for high-power USP lasers

Durch Leistungsskalierung kann das Präzisions-Werkzeug Ultrakurzpulslaser systemrelevante Märkte erschließen.



Ultrakurzpulslaser



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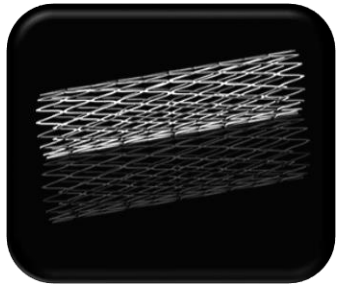

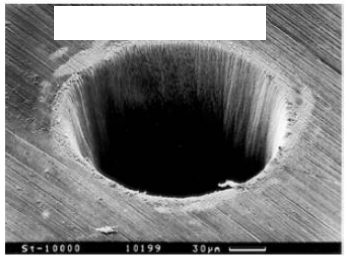

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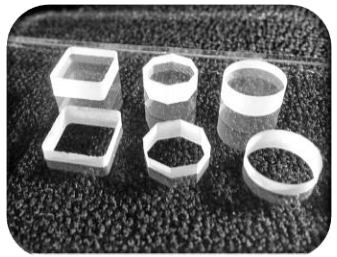

Präzision

Digitale Steuerbarkeit

Materialunabhängigkeit

Geringer Durchsatz

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Skalierung zu hohem Durchsatz

Erschließung systemrelevanter Märkte

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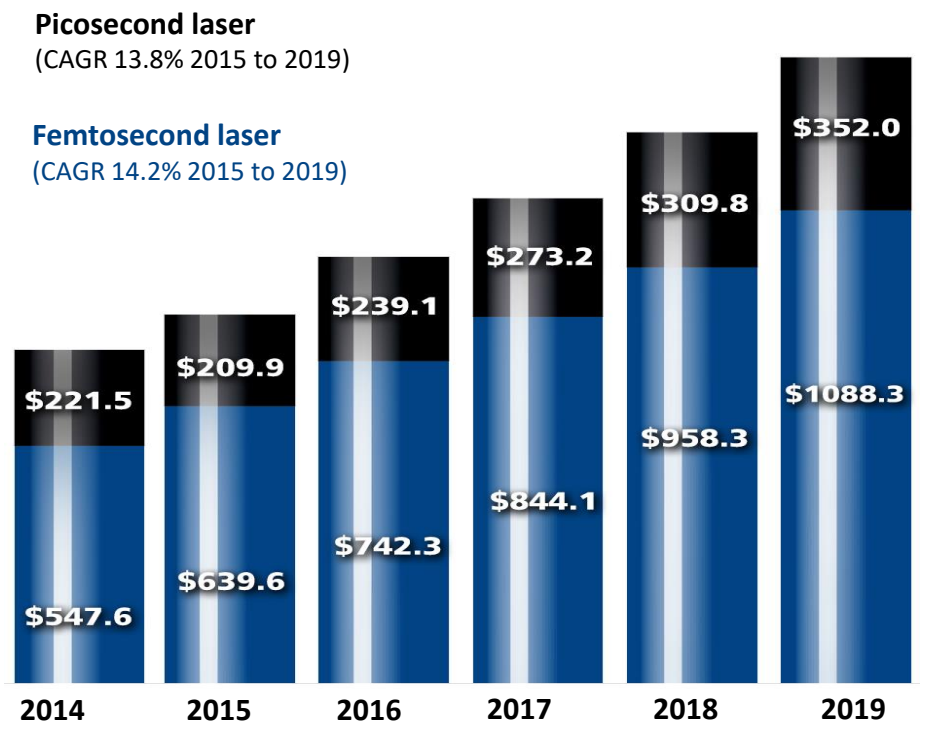
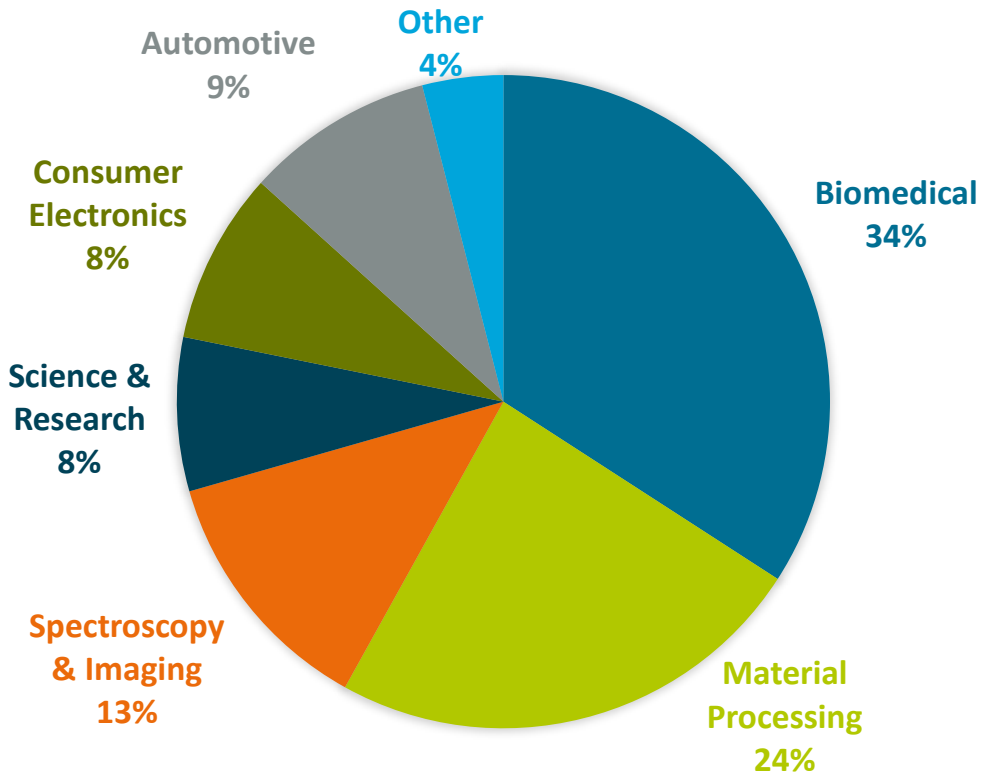
Ultrakurzpulslaser sind Wachstumsmarkt und Key-Enabling Technology.



Quelle: Strategies Unlimited, © PennyWell



Quelle: bccResearch, Ultrafast Lasers: Technologies and Global Markes, November 2018

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Aim of Center for Advanced Photon Sources CAPS

- Devoloping high-power ultra-short pulsed laser systems
- Establishing the fundamentals of a >>10kW and >>10mJ UKP laser source based on ytterbium-doped multinuclear fibers

1 kW Frontend

5 kW Innoslab amplifier

10 kW disk booster

What to do with all the power?

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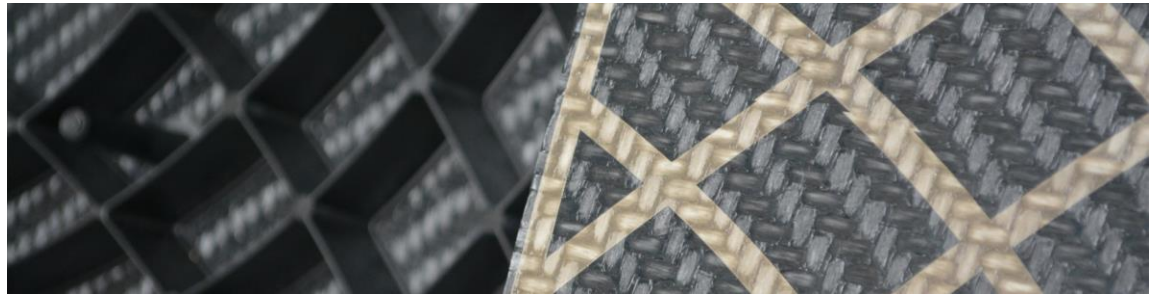
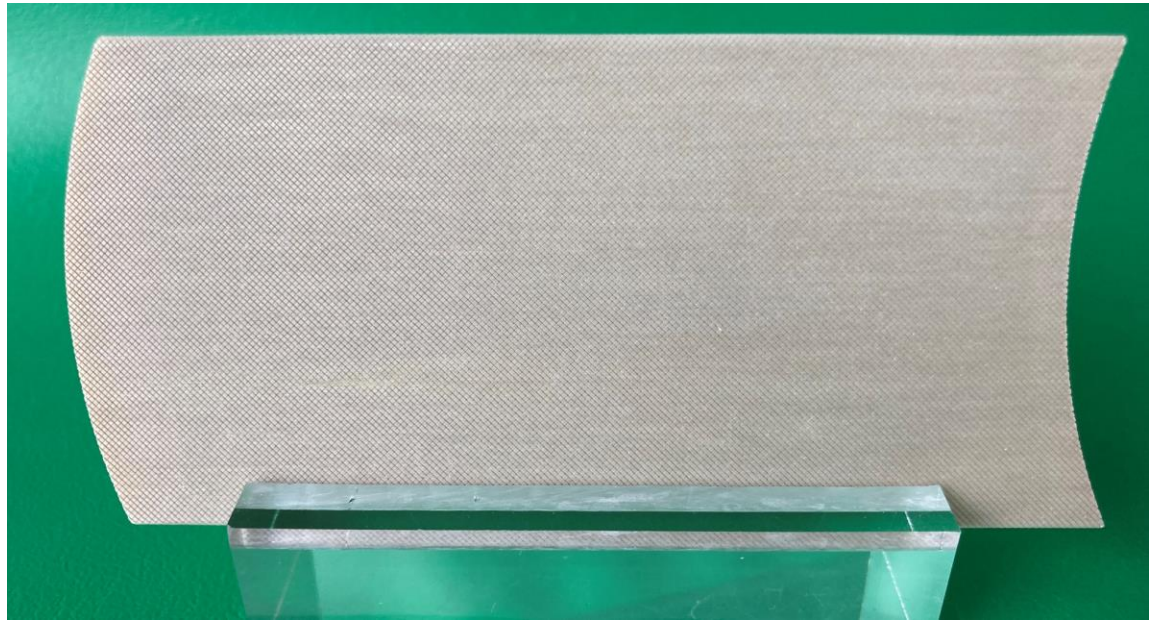
Applications for high-power USP lasers

High Throughput High Precision Machining for Lightweight Design

- Cutting of fiber reinforced plastics with increased cutting speed and low thermal impact
- Cutting of complex heterogeneous composites (polymer matrix + reinforcing fiber + metal inlays) with only one tool
- Surface patterning of metal inlays prior to pultrusion process to increase adhesion strength without additional adhesion agents
- Surface patterning of fiber reinforced plastics to strengthen interface for subsequent additive manufacturing





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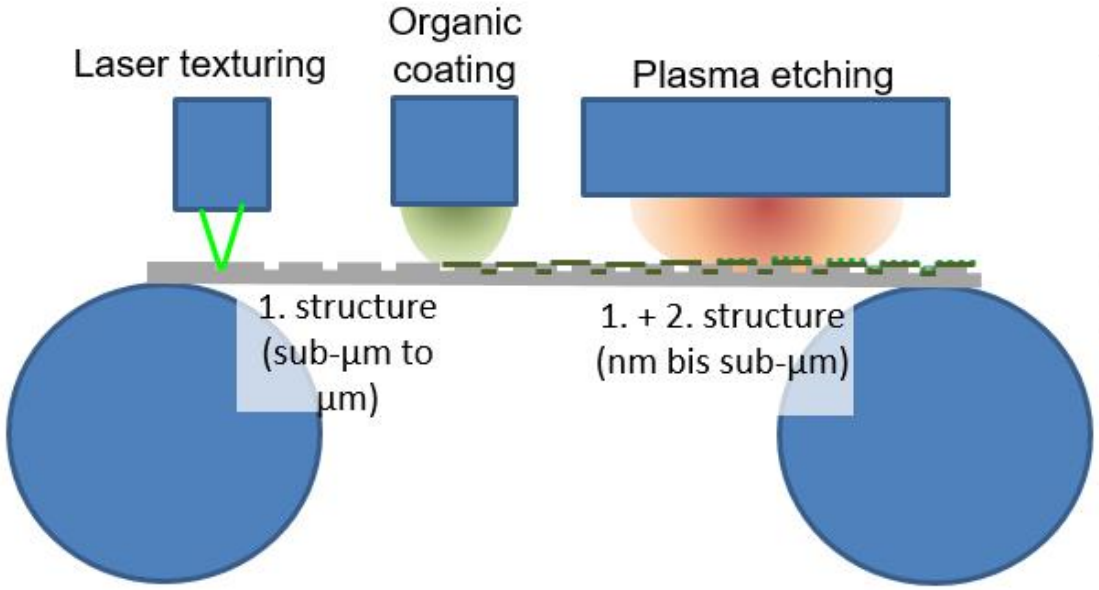
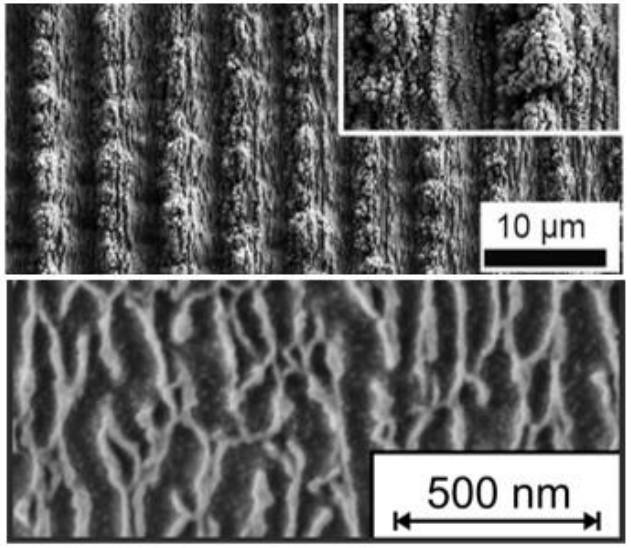
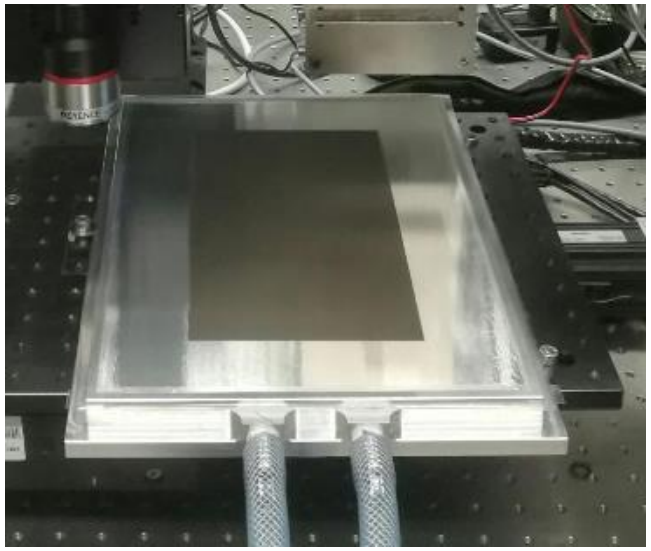
Functionalized metal foils for anti-icing applications

- Roll-to-Roll processing using Direct Laser Interference pattering on metal foils
- Post-Processing using PVD processing of organic layers and plasma etching to produce hierarchical structures







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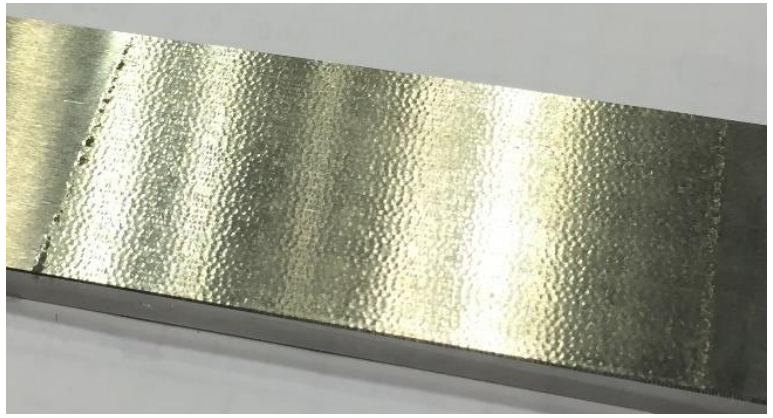
Optimization of Residual Stresses and Material Properties on Metallic Surfaces

Aim:

- Qualification of picosecond ultra-short pulsed laser for strain hardening
- Targeted influence on residual stress fields and other surface properties of metallic surfaces (i.e. steel, aluminum, soft iron)
- Development of dry peening process without protective coating and confining water layer

Application:

- Increase of lifetime of sintered or additively manufactured components
- Post-treatment of welded components



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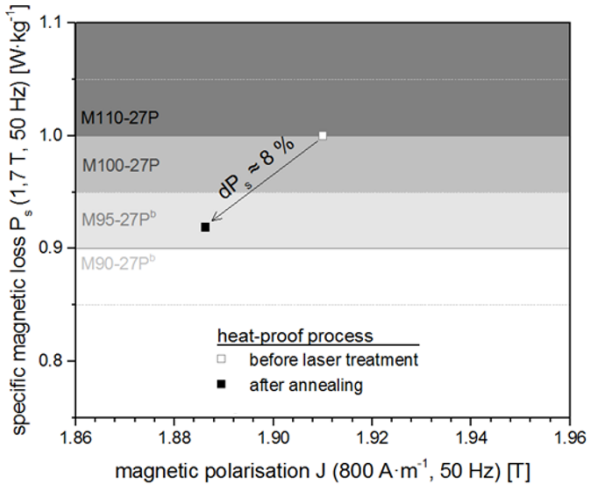
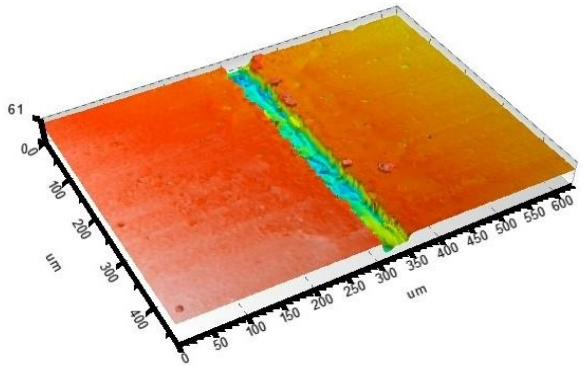
Structuring of Electrical Sheets for Energy Transfer using Multi-kW-USP Laser

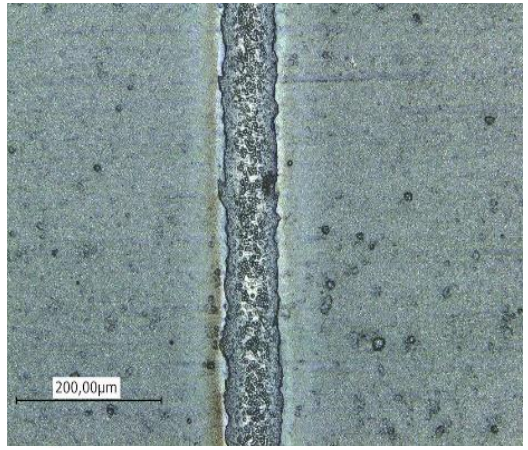
- Increase of efficiency of power and distribution transformers
- reduce the magnetization losses of app. 8% by creating structural defects in form of grooves
- Achievement of excellent surface quality without debris and burr
- Processing speed comparable with speed achieved by mean of high power cw fiber laser



Distribution transformer, source SBG



Groove created by cw laser



Groove created by USP laser

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