AMPHOS – Facts and Figures

- Founded in Feb. 2010 (Spin-Off of RWTH Aachen and Fraunhofer ILT)
- Location: Technology Park Herzogenrath, close to Aachen
- Office and laboratory space > 1.000 m²
- Employees: >30
- AMPHOS Worldwide:
  - Representatives / Distributors in Asia (Japan / Korea)
  - Subsidiary “AMPHOS Inc. “ (Springfield, MA)
Management Team with more than 15 years Experience in Laser Technology

- **AMplifying PHOtonicS** - Amplifier Systems with focus on Ultrashort Pulse Lasers
- AMPHOS manufactures world record High Average Power Ultrafast Lasers:
  - Multi-100W average output power
  - Pulse duration from 500fs...10ps
  - Pulse energy up to mJ range
- AMPHOS Laser Systems are based on „Yb:InnoSlab“ Amplification Technology
- „True“ RWTH / Fraunhofer Spin-Off

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AMPHOS Motivation: USPL Mark a New Age in Laser Materials Processing

- Ultrashort Pulse Lasers:
  - extremely precise, „cold“ ablation

- Advantages:
  - Any material can be processed
  - No heat affected zone
  - Remote, contactless Process

- Application areas:
  - Photovoltaics (thin film ablation)
  - Surface structuring
  - Drilling, Cutting (Turbo engines)
  - EDM (metals and dielectrics)
  - Composite Materials

AMPHOS Laser systems allow for higher throughput due to highest output power in ps and fs regime
AMPHOS Production Line

- Production tools (e.g. crystal soldering)
- Design of opto-mechanical / electrical components / subsystems
- Cleanroom assembly
- Table top laser system
- AMPHOS control software
AMPHOS Products –
One System Architecture for Wide Parameter Range

• Optical parameters: up to 40MHz / up to 3mJ
• System architecture: one interface / all parameters by software
• Control Unit: 19” wide and 3-4 HU

AMPHOS 10
• >10 W output power
• 800fs ... 6ps
• $M^2 < 1.5$
• compact size (40 x 30 x 15 cm³)

AMPHOS 200
• >200 W output power
• 800fs ... 10 ps
• $M^2 < 1.5$
• 100 W version
• robust system design (50 x 50 x 16 cm³)

AMPHOS 400
• >400 W output power
• 800fs ... 10ps
• $M^2 < 1.5$
• scalable to >1000 W
• scientific applications (110 x 60 x 15 cm³)
Scientific Applications

- AMPHOS Lasers are installed in major research facilities
- Example: European XFEL and DESY Laboratory in Hamburg
- Application: OPCPA for generating <10fs pulses ("few-cycle pulses")

- World record 20kW amplifier chain has been developed and installed
- Three more systems will be installed for 24/7 operation from 2016
AMPHOS Application Lab

- Currently installed:
  - 300W Laser System, 1030nm, <1ps...10ps
  - Galvo scanner (f=80mm / 163mm / 254mm) lenses (SILL TZ)
  - 3-axes moving stage

AMPHOS offers feasibility studies for processing different materials
Results of Materials Processing: High Average Power Translates Into Processing Speed

Fused Silica  |  CFRP  |  In Volume Selective Laser Etching (SLE)  |  Compound Wafer

Blackening of Metals  |  Waveguide Structures  |  Processing of Metal  |  Strengthened glass

Output Power of 150 W (@500fs & 6MHz): Ablation rate in the range of 1-2 mm³/s
SLE Results

Source: Fraunhofer ILT, Lightfab
CFRP Machining with AMPHOS Lasers
Cut Through 1.8mm Thick Material

Ablationrate > 2 mm³/s*

*150W output power, optional 400W / 1000W
• Basic Idea: Optimize the geometry of a metallic insert to increase pull-out force and breaking torque

• First Results have been achieved: +74% increased pull-out force!
Summary

- AMPHOS is technology leader in High Average Power Ultrafast Lasers

- InnoSlab amplification technology using a Yb:YAG laser crystal allows for highest output power in the Ultrafast regime
  - up to mJ pulse energy, multi 100W output power
  - GW pulse power,
  - diffraction limited beam quality

- The simple setup results in an efficient pumping scheme and a extremely compact setup

From science to industry – a lot of applications and products benefit from those outstanding properties
AMPHOS in Japan
Japan Laser Corporation - JLC

- Japan Laser is the oldest trading organisation for Laser in Japan (since 1968)
- President: Nobuyuki Kondo
- Three offices in Japan (Tokyo, Osaka, Nagoya)
- Specialists for applications from Science to Industry