



## Ultrafast meets ultrahard

Pulsed laser ablation  
technologies for ultrahard  
tooling

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Thursday 13 November

ETH Zurich  
Rämistrasse 101  
HG E3  
8092 Zurich



**SWISS PHOTONICS**

## DIPLAT:

DIPLAT is collaborative research project funded by the European Commission to investigate and demonstrate the ability for an integrated Pulsed Laser Ablation (PLA) technology to produce diamond and cBN tools with enhanced functionality for high performance and ultra precision machining operations

## The open meeting will explore the following topics:

- Industrial potential for short and ultra-short pulsed laser machining of ultra-hard materials
- CAM/Simulation developments of the ultra-short laser pulse machining
- Latest advances in multi-axis laser production centers
- Novel laser manufacturing strategies for grinding, polishing and micro-tools

Networking-apéro at the end of the event sponsored by Swissphotonics

## More information

Find more information about the event on

<http://www.fp7-diplat.eu>

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**ETH**

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*Einladung zum Fertigungstechnischen Kolloquium  
vom 13. November 2014, 13:00 – 18:00 Uhr*

## Laser machining of ultra-hard materials

*Hörsaal ETH Hauptgebäude HG E 3, Rämistrasse 101*

### **Recent developments on ultrahard material systems for tooling applications**

*Chris JH Wort, Element Six Group, De Beer Group of companies*

The hardest material known to man is diamond and pure diamond tooling can be produced by High Pressure High Temperature (HPHT) routes or by Chemical Vapour Deposition (CVD). Although pure diamond is exceptionally hard, it is also brittle which limits applications to non-interrupted cutting or wire drawing. HPHT can also produce a poly crystalline diamond (PcD) which is actually a composite of fused diamond grains in a matrix of cobalt. Different diamond grain sizes, combined with changes in HPHT conditions now results in a range of tough yet still hard materials that can be tailored to different machining applications, from non-ferrous metals to rocks. To machine ferrous materials, the second hardest material is polycrystalline boron nitride (PcBN) and this can also be synthesised by HPHT routes; however, PcBNs are not congruent (i.e. no cBN to cBN bonding) and rely on a second, binder phase to make the composite. It is often the properties of the binder phase that determines the best material for a given machining application.

This talk will try to explain which material system is most applicable for a given application and where Element Six see new opportunities going forward.

### **Advanced control and machinery for tool processing with ultrafast lasers**

*Dr. Claus Dold, EWAG AG, United Grinding Group*

The generation of cutting tools leads to a large variety of geometrical features on a multitude of scales from micro- to millimeters. Due to the 3-dimensional complexity of the tool shapes a fully synchronized CNC-, optical axes and laser beam motion control is necessary. The high potential in cutting tool manufacturing enabled by the current developments in hardware and software for axes synchronization will be presented in this talk as well as the progress in process simulation which supports the laser process development itself.

### **Laser pulse ablation strategies for advanced abrasive surfaces and micro tools**

*Dr. Paul Butler-Smith, Machining and Condition Monitoring Group, University of Nottingham*

DIPLAT has facilitated a detailed study of the response of diamond and its related materials to high photon energy absorption with view to enabling the production of precision micro and macro tools using pulsed laser ablation. The resulting advancements in the scientific understandings of the pulsed laser ablation process is enabling the laser generation of complex three-dimensional profiles in these ultrahard materials which cannot be readily achieved with mechanical process such as grinding.

This presentation covers the fundamentals on pulse laser ablation and material removal considering single pulses, controlled overlapped pulses, multi scans and scanning directions leading to the generation of advanced abrasive surfaces and micro tools incorporating controlled micro-geometries for industrial applications.

### **Tangential ultrashort pulsed laser processing for diamond tool finishing applications**

*Maximilian Warhanek, Institut für Werkzeugmaschinen und Fertigung IWF, ETH Zürich*

The availability of high powered ultrashort pulsed laser sources enables the efficient application of tangential strategies for the processing of various diamond tool geometries such as twist drills and dressing rollers. Compared to conventional 2.5D volume ablation, the resulting workpiece form tolerance, repeatability and surface quality is increased significantly and does not depend on the quality of the initial state. Additionally, ultrashort laser pulses allow wear-free processing without thermal damage to the workpiece while also avoiding the considerable mechanical loads from conventional diamond processing methods. This makes tangential ultrashort pulse laser processing an ideal choice for high precision finishing of diamond tools.



*“Diamond and other ultra-hard materials by Integrated Pulsed Laser Ablation Technologies” (DIPLAT), EU project, [www.fp7-diplat.eu](http://www.fp7-diplat.eu)*

[www.iwf.mavt.ethz.ch](http://www.iwf.mavt.ethz.ch)

## Fertigungstechnisches Kolloquium: **Laser machining of ultra-hard materials**

Donnerstag, 13. November 2014, 13:00 – 18:00 Uhr

Ort **ETH Zentrum, Rämistrasse 101, 8092 Zürich,  
Hauptgebäude, HG E 3**

*Eine Voranmeldung ist nicht nötig. Programmänderungen sind jederzeit möglich. Keine Parkplätze. Wir freuen uns auf Ihre Teilnahme.*

### Programm:

13:00-13:15 **Welcoming speech Prof. K. Wegener, IWF ETH Zurich**

13:15-14:00 **Recent developments on ultrahard material systems for tooling application**  
*C. Wort, Element Six Group, De Beer Group of companies*

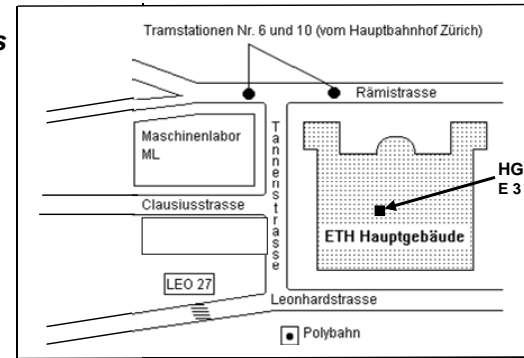
14:00 -14:45 **Advanced control and machinery for tool processing with ultrafast lasers**  
*C. Dold, EWAG AG, United Grinding Group*

14:45 - 15:15 *Break*

15:15 - 16:00 **Laser pulse ablation strategies for advanced abrasive surfaces and micro tools**  
*P. Butler-Smith, Machining and Condition Monitoring Group, University of Nottingham*

16:00 - 16:45 **Tangential ultrashort pulsed laser processing for diamond tool finishing applications**  
*M. Warhanek, Institut für Werkzeugmaschinen und Fertigung IWF, ETH Zürich*

16:45 -18:00 **Networking Apéro**  
*sponsored by Swiss Photonics*



**Bitte reservieren Sie sich auch die Termine für die weiteren Fertigungstechnischen-Kolloquien:**

Do 27.11.2014 *Betriebliche Optimierungen in der industriellen Fertigung*  
Do 11.12.2014 *Innovative Schweißverfahren*

# ETH

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