



Technology Transfer and International Co-Operation

Μεταφορά Τεχνογνωσίας και Διεθνής Συνεργασία

The Fraunhofer Model

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Werkzeugmaschinenlabor (WZL) an der RWTH Aachen
Fraunhofer Institute for Production Technology (IPT)
Aachen

Greek-German Workshop on Innovation in the context of
cooperation with Western Balkan Countries

Centre for Research and Technology Hellas – CERTH
Thessaloniki, October 3rd, 2011

Outline

- Fraunhofer Gesellschaft
- Fraunhofer IPT and PCCM
- Case Studies
- Future Perspectives

The Fraunhofer-Gesellschaft



Fraunhofer Gesellschaft is a non for profit research organisation

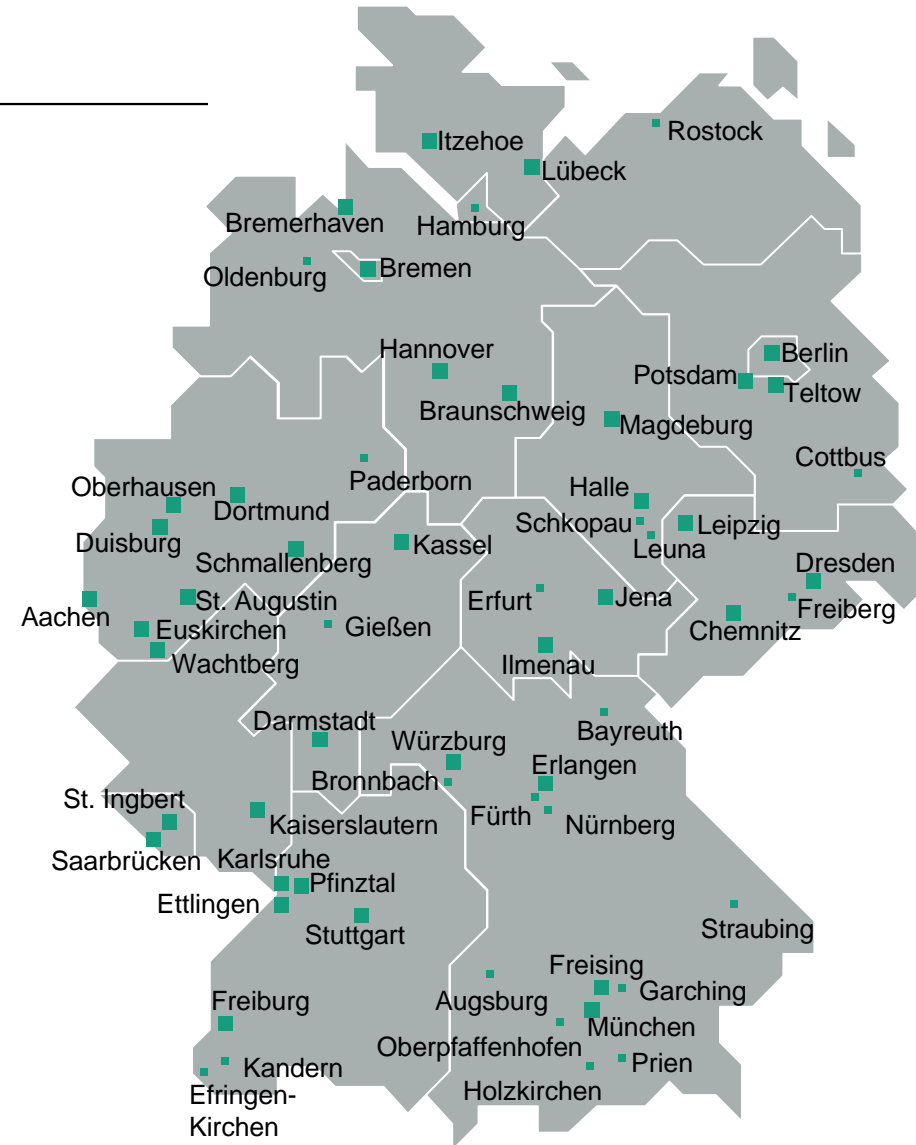
The Fraunhofer-Gesellschaft does applied research for private and public enterprise and research institutions

Our Clients:

- Industry
- Service sector
- Public administration

Fraunhofer is the largest organization for applied research in Europe

- Founded in 1949
- More than 80 research institutions, including 60 Fraunhofer institutes
- More than 18,000 employees
- Annual research volume of €1.7 billion
 - General Target:
 - 1/3 Public base funding
 - 1/3 Industry contracts
 - 1/3 government sponsored research programs
- International representation through representative offices, research centers and project groups



Production Technology in Aachen



Laboratory for Machine Tools and Production Engineering (WZL)

- RWTH Aachen University institute
- Founded in 1906
- 570 employees
- 10,000 m² offices and laboratories



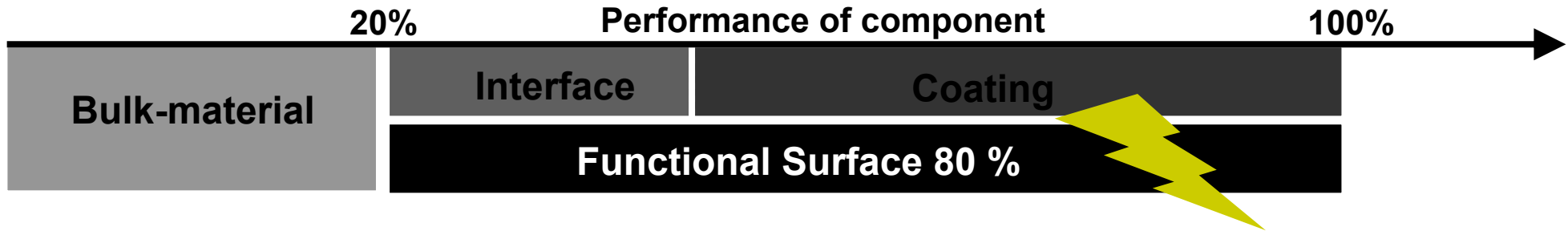
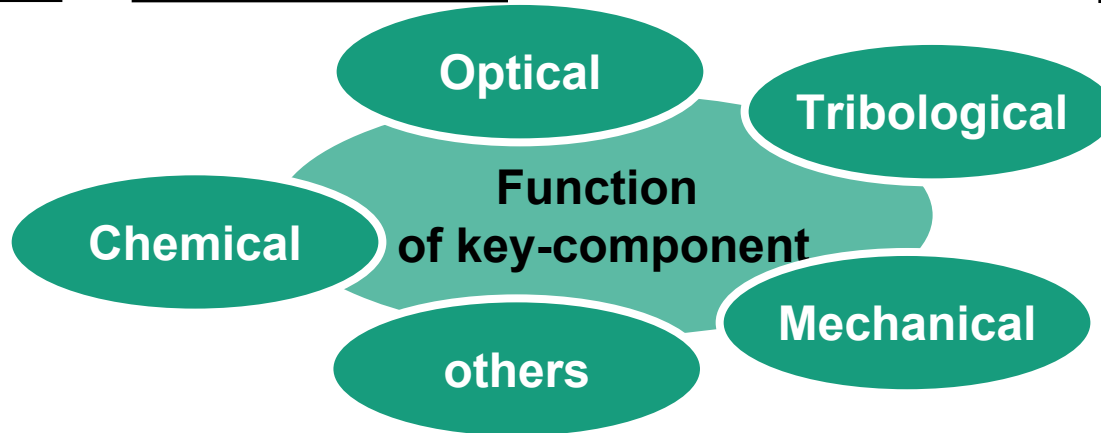
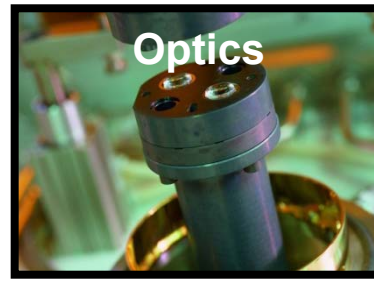
Fraunhofer Institute for Production Technology IPT

- Founded in 1980
- 250 employees
- 3,000 m² offices and laboratories
- Certified to DIN EN ISO 9001:2000
- Fraunhofer Center for Manufacturing Innovation CMI,
 - Boston, USA
- Project Center for Coatings Manufacturing, PCCM,
 - **Thessaloniki, Greece**
- Project Group for Mechatronics,
 - Paderborn, Germany

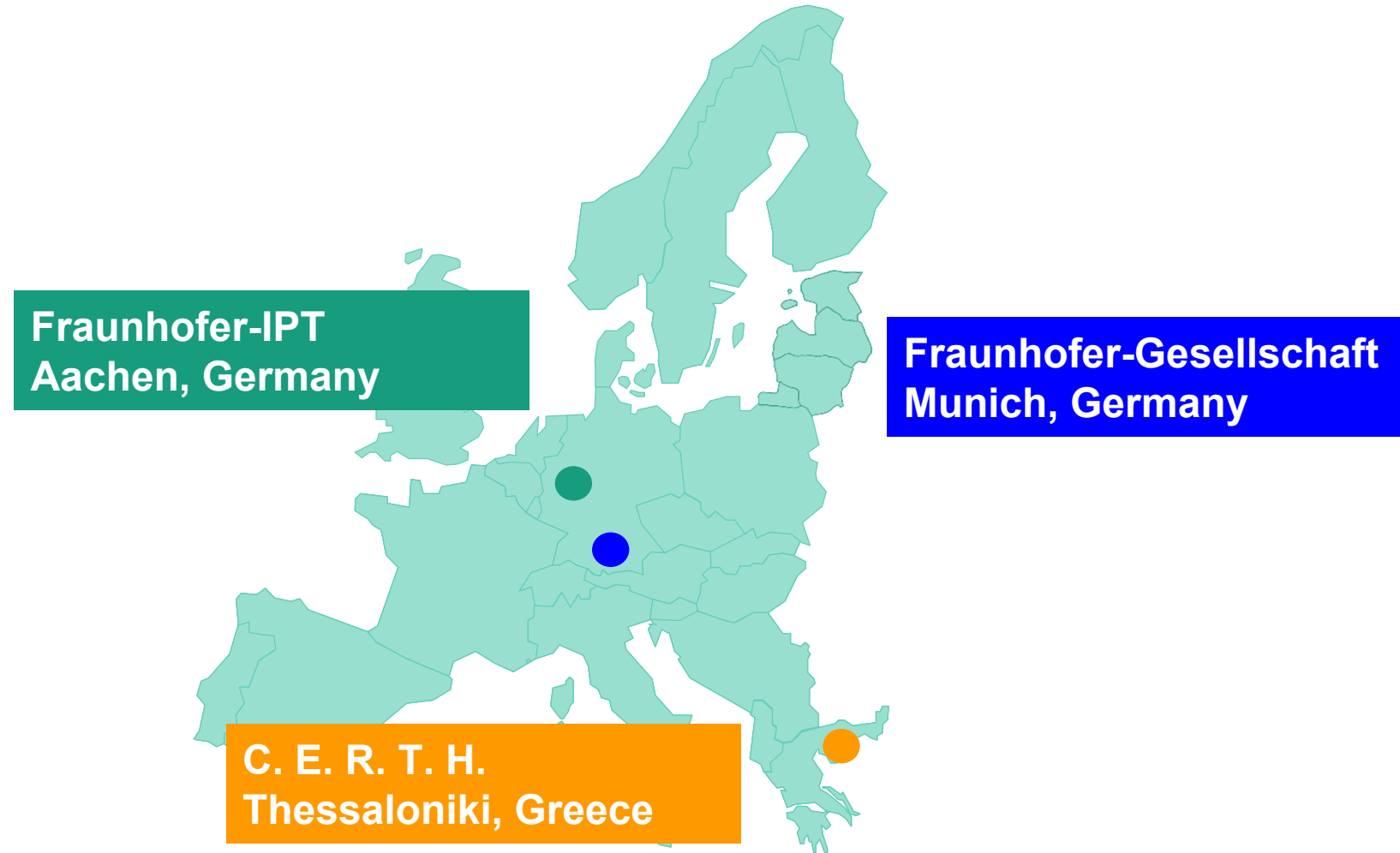
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Objective, research need, relevance for industry: Functional Surfaces



Strong Partners in Engineering ...



Fraunhofer Project Center for Coatings in Manufacturing PCCM

Structure

Cooperation between Fraunhofer represented by Fraunhofer IPT and the Centre for Research and Technology Hellas CE.R.T.H. represented by the Manufacturing Institute of Thessaloniki MITh

Research areas

Development and qualification of high performance coatings for cutting and forming tools

Holistic consideration of entire process chains

Understanding of coating processes, simulation of coating properties and prediction of coating performances by using model tests



September 23rd, 2008: Signing of the contract governing the establishment and operation of Fraunhofer PCCM

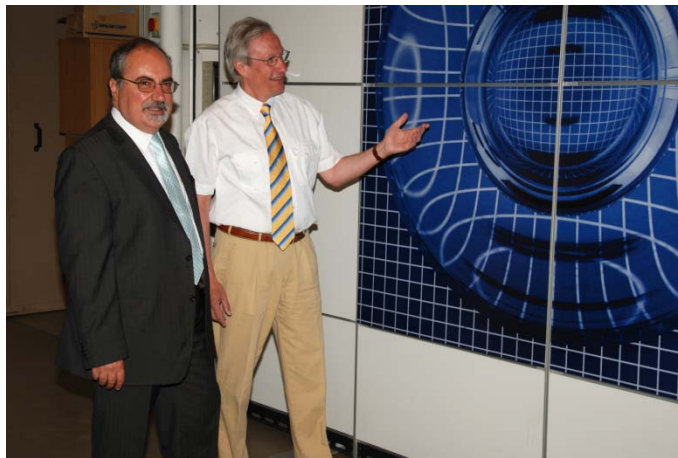
From left to right:

Prof. F. Klocke, Prof. I. Tsalidis, Prof. U. Buller, Prof. K. Kyparresidis, Prof. K.-D. Bouzakis

Official Inauguration in 2008



Official Inauguration in 2008



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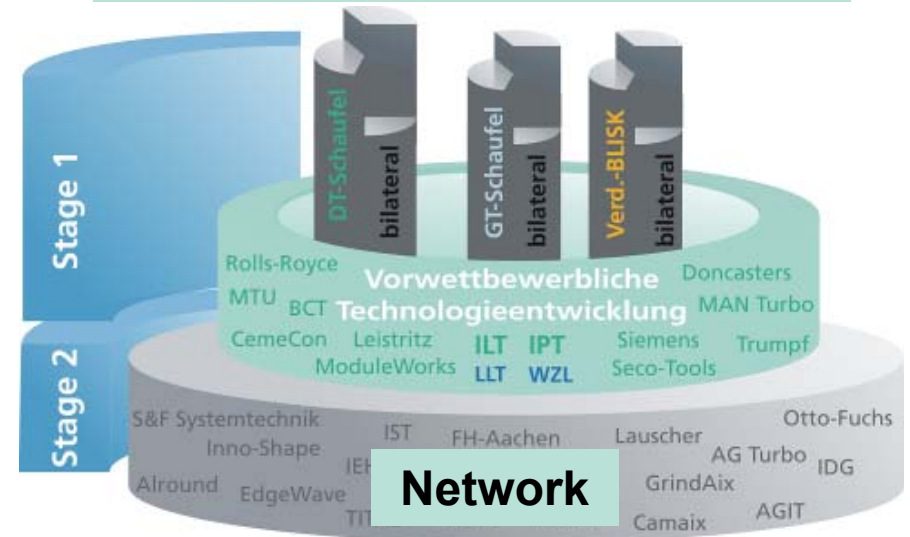
TurPro

New Generation Manufacturing of Turbo Machine Components

- **Vision/Problem:** To develop and implement integrative production technology for energy-efficient turbo machines (power generation, aircraft, mobility)
- Joint approach between **Industry - Fraunhofer IPT/ILT - Certh/PCCM**
- **Output/Impact**
 - Use of advanced super alloys
 - Increase in productivity
 - Customized coatings (tooling)
 - Robust processes
 - Cost Reductions along life cycle
 - Fully automatized repair
 - Sustainability



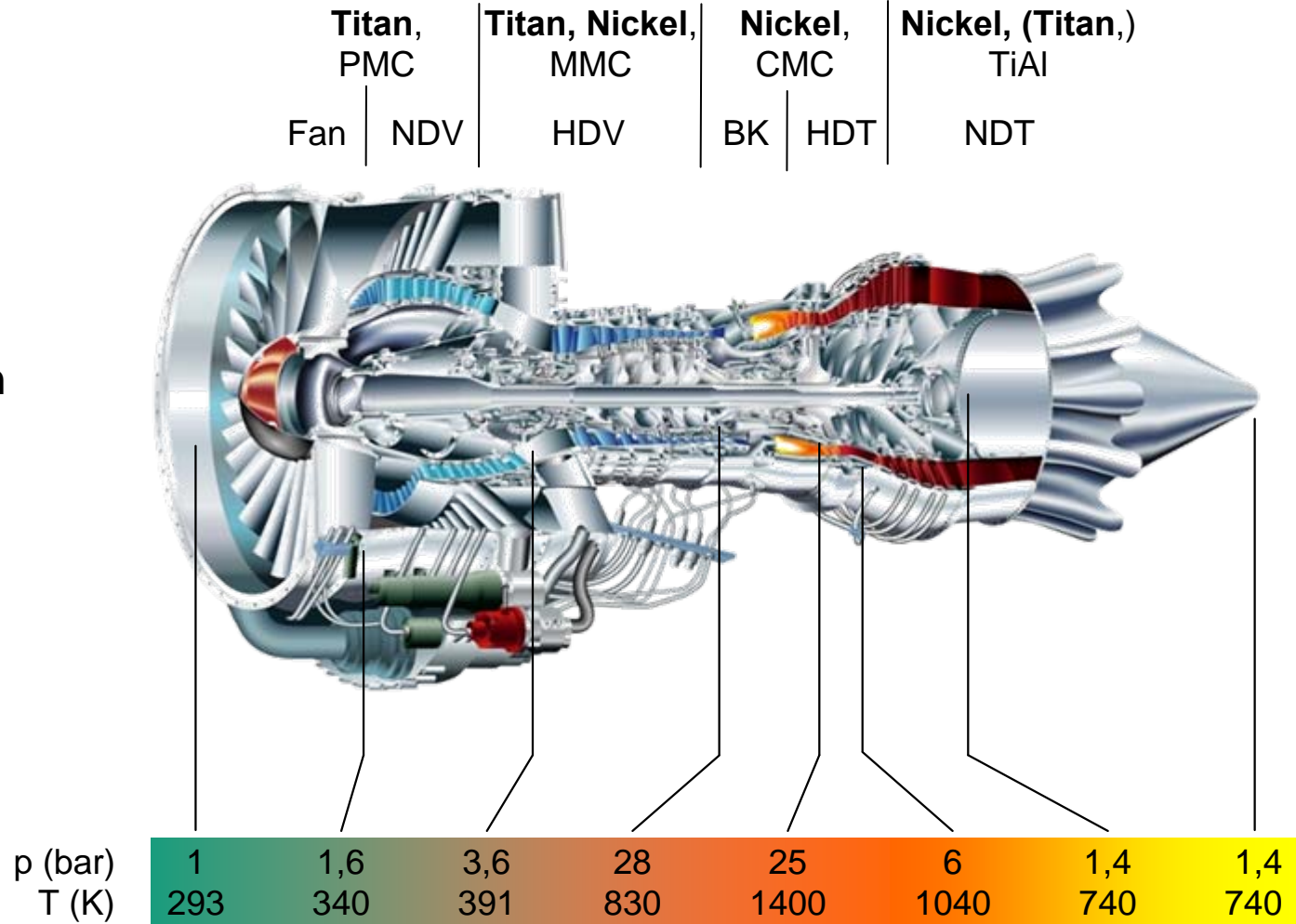
**Pre-competitive
technology development**



Materials for in high performance air engines

- Titanium
- Nickel
- Steel
- New materials and design

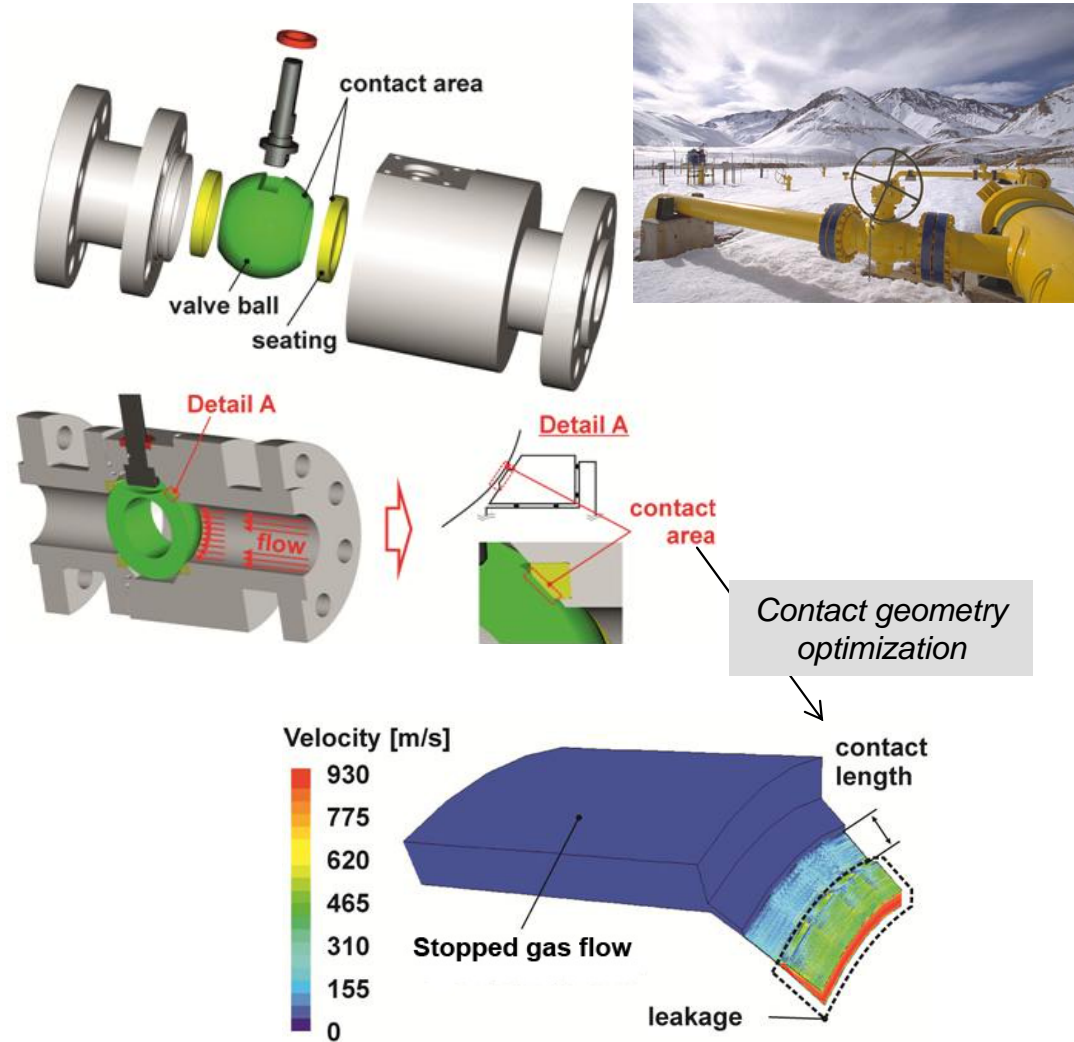
- Titan-Aluminide
- PMC: Polymer Matrix Composites
- MMC: Metal Matrix Composites
- CMC: Ceramic Metal Composites



Quelle: MTU Aero Engines

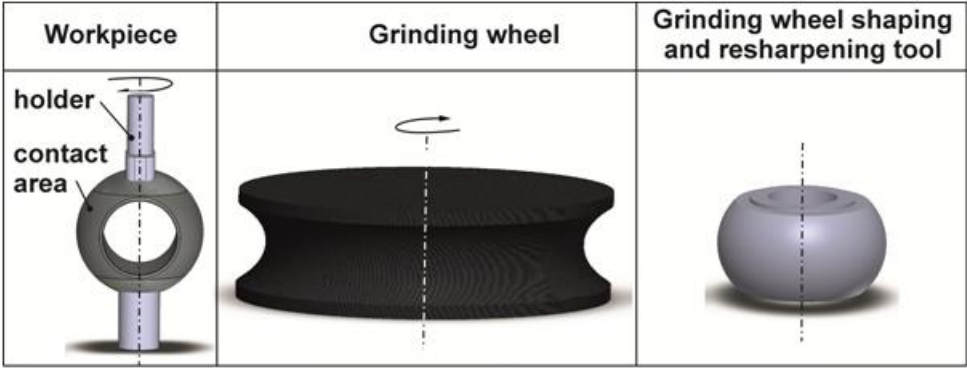
Ball valves with PVD coated Metal-to-Metal sealing mechanism

- **Vision/Problem:** To develop a robust manufacturing chain for the production of coated ball-valves, to be implemented in gas transport. To attain high operational performance and long life span.
- Joint approach between **Industry - Fraunhofer IPT - Certh/PCCM**
- **Output/Impact**
 - Application of sophisticated design and product optimization techniques
 - Application of high precision grinding
 - Use of advanced diamond like coatings (DLC)
 - Robust production processes
 - Decrease in operating torque by more than 40%
 - Increase in life expectancy by 5 times
 - Reduction of repair costs along life cycle



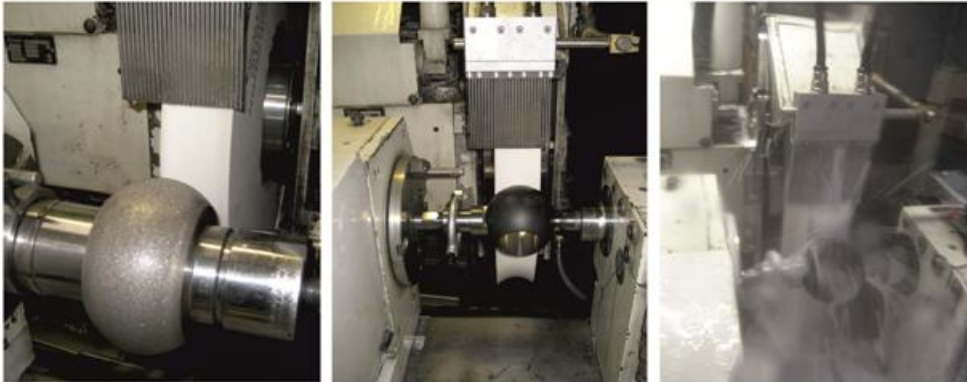
Ball valves with PVD coated Metal-to-Metal sealing mechanism

Ball grinding process

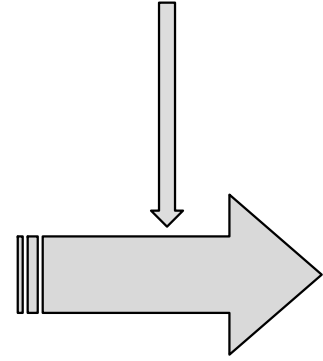


Grinding wheel shaping

Grinding of the valve ball



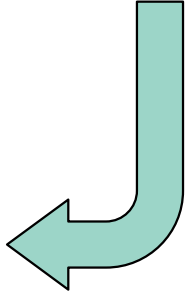
Diamond Like Coating deposition



Coated ball-valve and seating



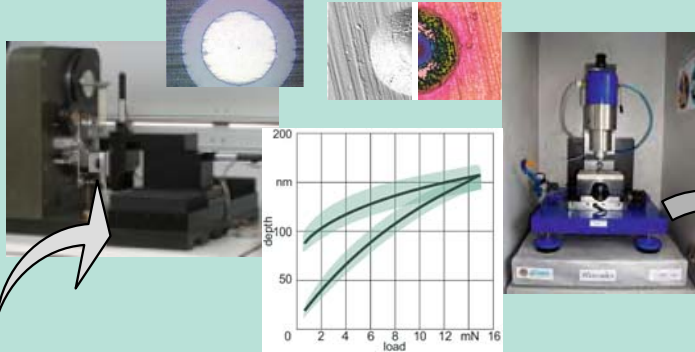
Ready-to-Market Product



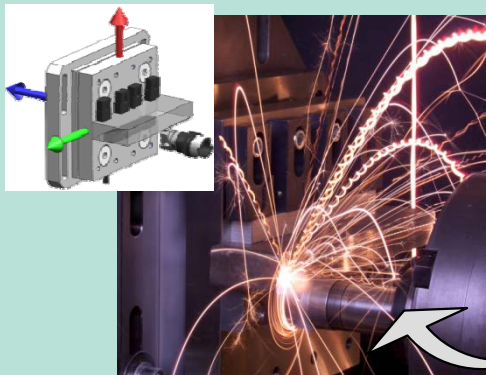
Characterization/Qualification of PVD Coatings for Heavy Duty Machining - PCCM

Approach

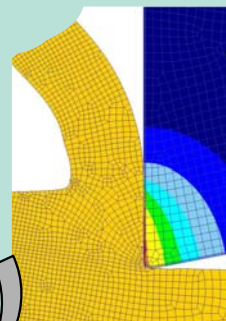
Advanced characterization



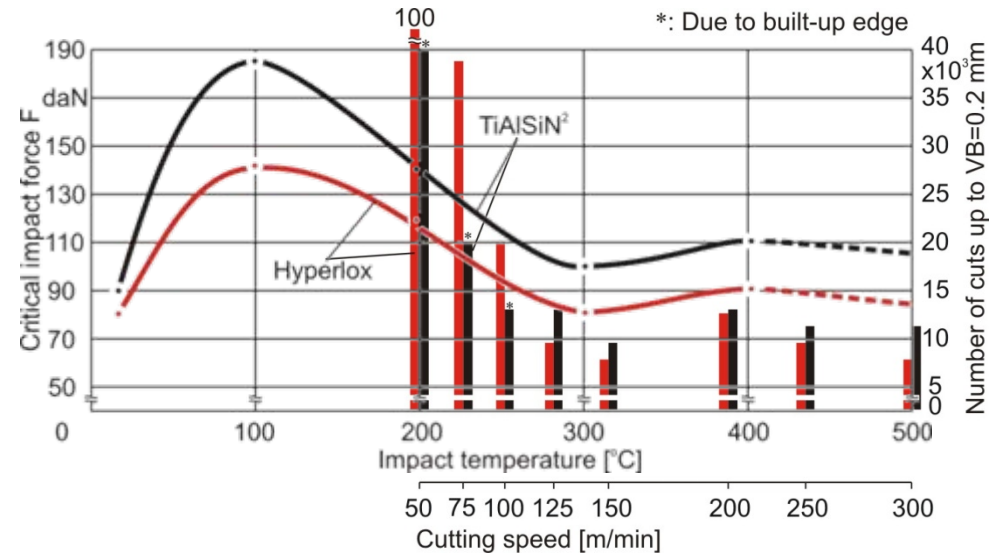
Reference cutting tests



FEM simulation



Correlation of the coating characterization results with the cutting conditions



- ✓ Customization of the cutting parameters tailored to the film properties
- ✓ Maximum tool utilization with respect to tool wear and productivity rate

Development of Si-containing coatings for hard-to-machine materials

- **Vision/Problem:** To develop Si-containing coatings as an alternative in high performance cutting of hard-to-machine materials

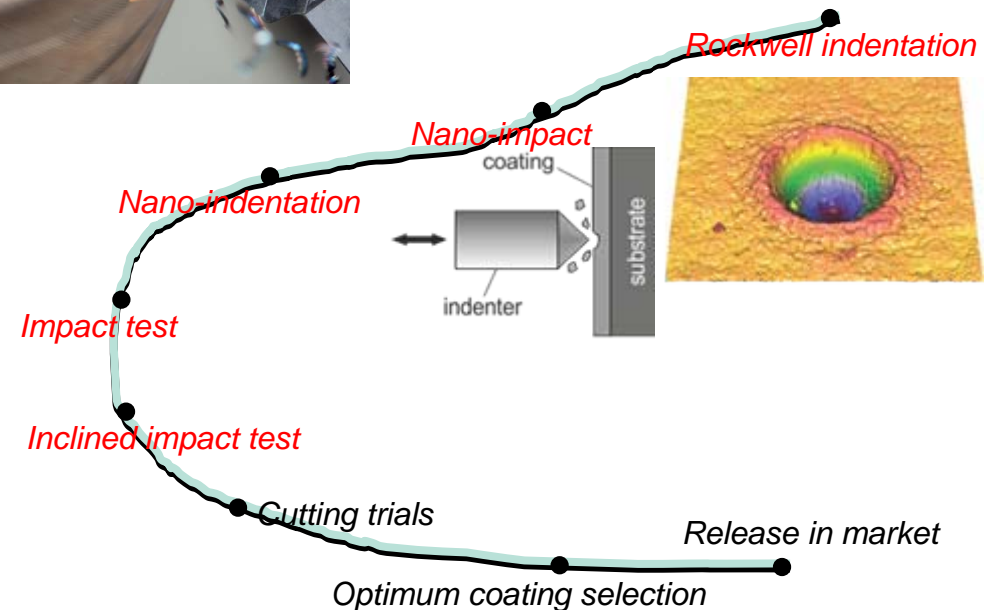
- Joint approach between **Industry - Fraunhofer IPT - Certh/PCCM**
Output/Impact

- Deposition of various Si-containing coatings
- Holistic coatings' characterization
- Selection of the most promising
- Cutting trials for estimation of performance and comparison to reference coatings
- New coating in tool market
- Improved cutting performance
- Gain in productivity and cost

Cutting process



Coating variations



SpeedCoat

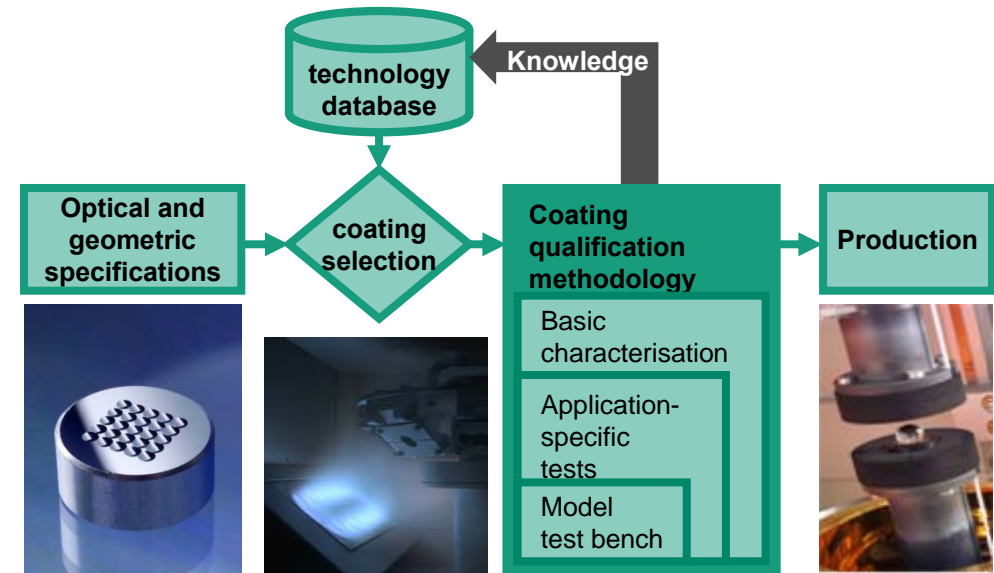
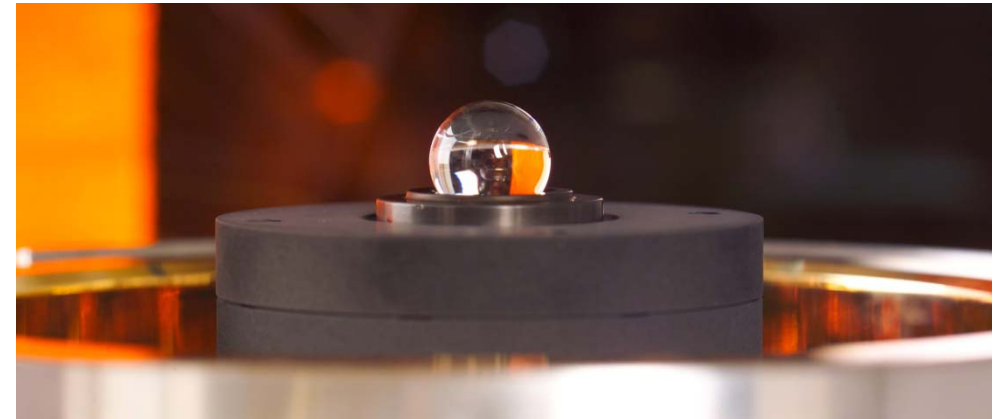
Technology platform for rapid coating qualification

- **Vision/Problem:** Development of an integrated technology platform for the rapid development, qualification and production of individually optimized coating systems for precision glass molding tools

- Joint approach between **Industry - Fraunhofer IPT - Certh/PCCM**

■ Output/Impact

- Development of new coating testing methods and equipment
- Understanding of the interactions between glass and molding tools
- Flexible adaptation of coating to different glass and substrate materials
- Improved efficiency and yield of precision glass molding process
- Enable application of process in industrial scale



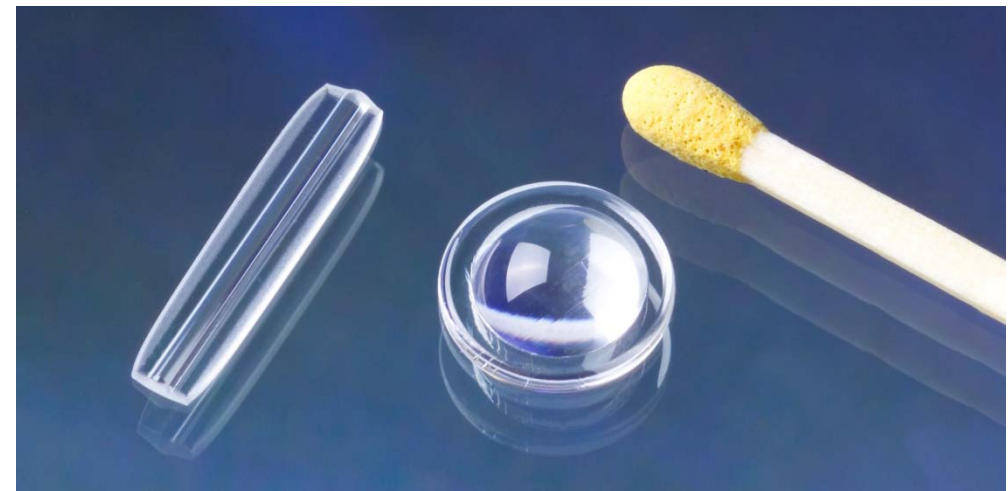
Production4μ

Replication of Complex Micro Optics

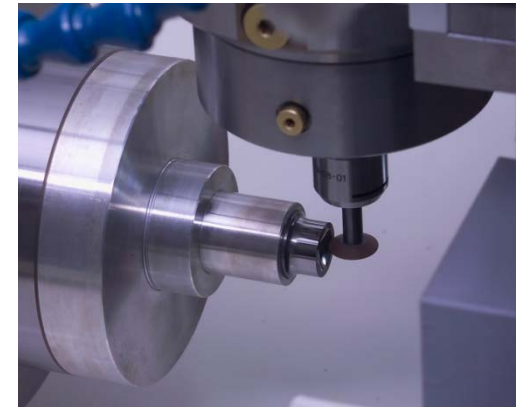
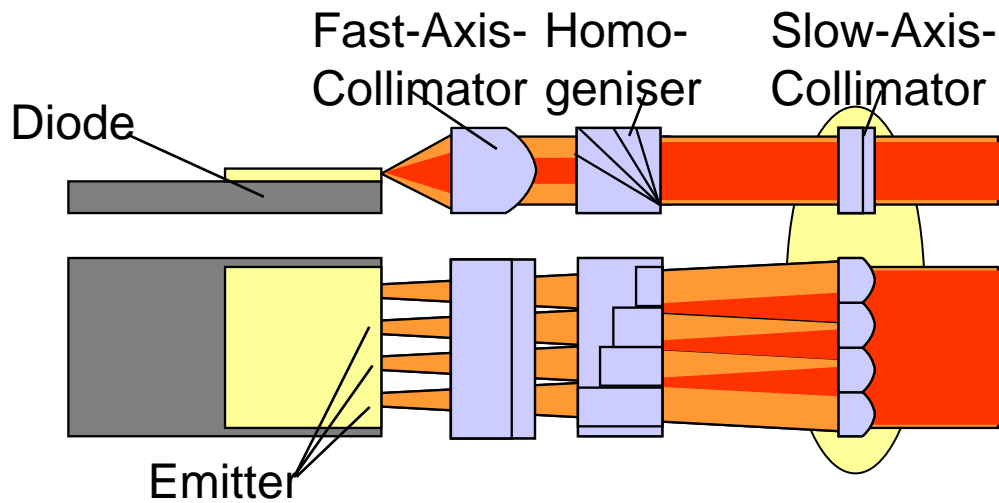
- **Vision/Problem:** Short time-to-market using reliable and economic manufacturing chains for new μ -components for emerging systems and applications
- Joint approach between **Industry - Fraunhofer IPT - Certh/PCCM**

■ Output/Impact

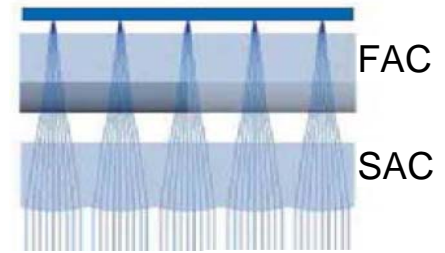
- Development of new methodologies and standards for integrated μ -production concept
- Introduction of new manufacturing processes and automation systems
- Transfer current lab-scale prototype production into industrial scale production
- Establish process chain for the manufacturing of complex glass components



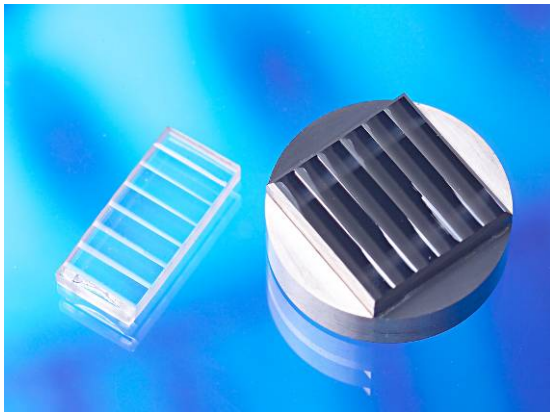
High Power Diode Laser



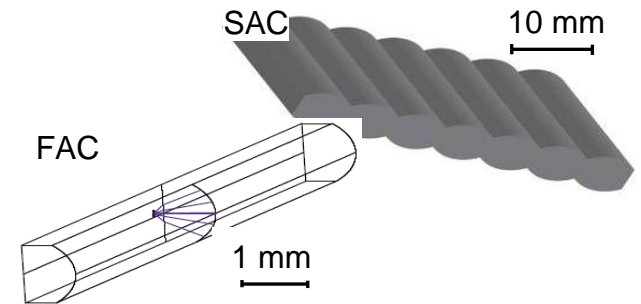
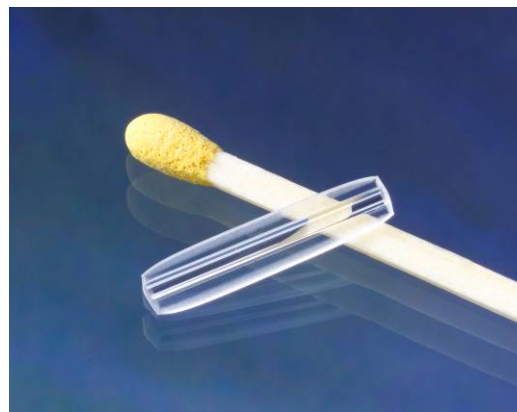
Laser Diode



SAC :P-V~200nm; Ra~2nm



FAC:P-V~500nm; Ra~15nm



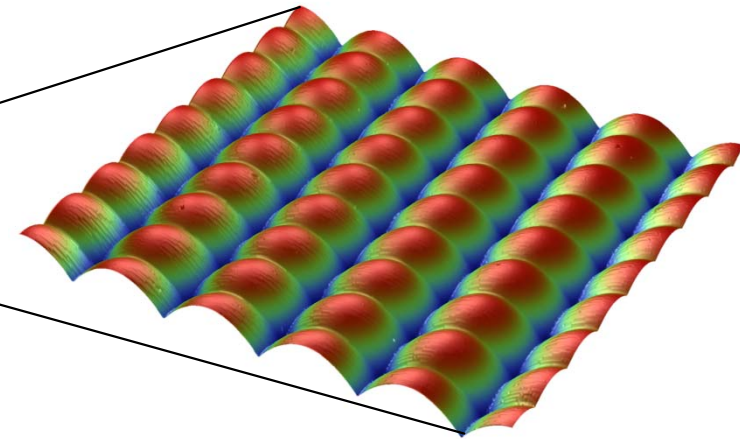
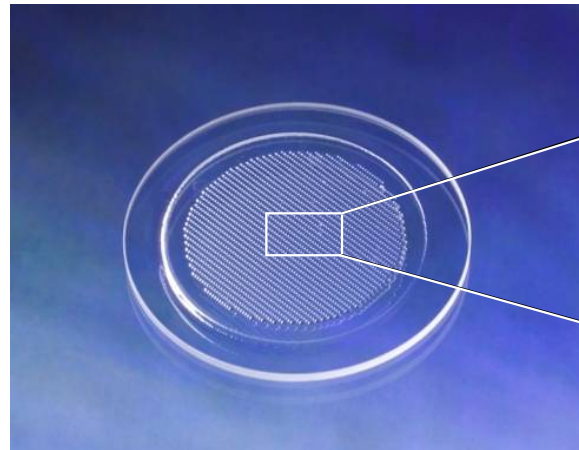
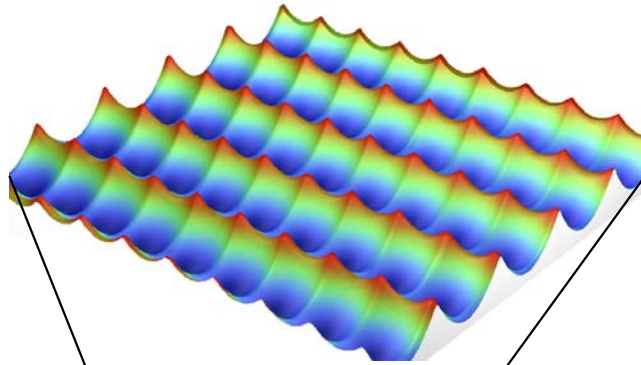
Condenser Lens Array

Specifications:

- Double-sided lens arrays to homogenize coherent as well as incoherent high power light sources
- 1760 shaped spherical lenses; 0.7 x 0.4 mm each

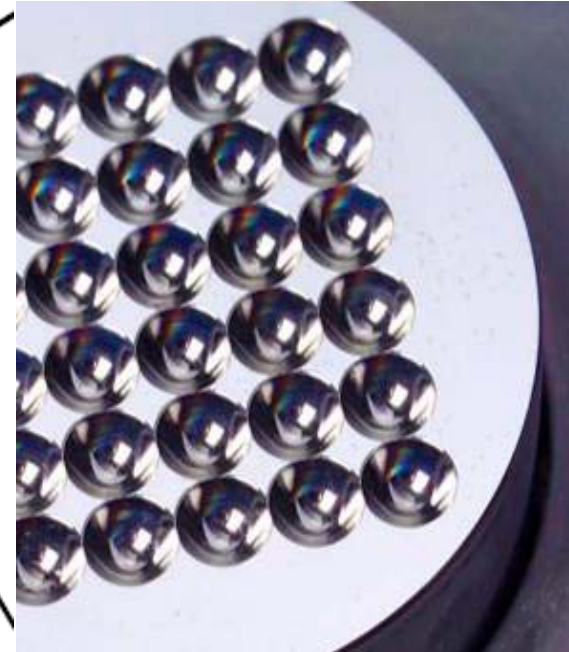
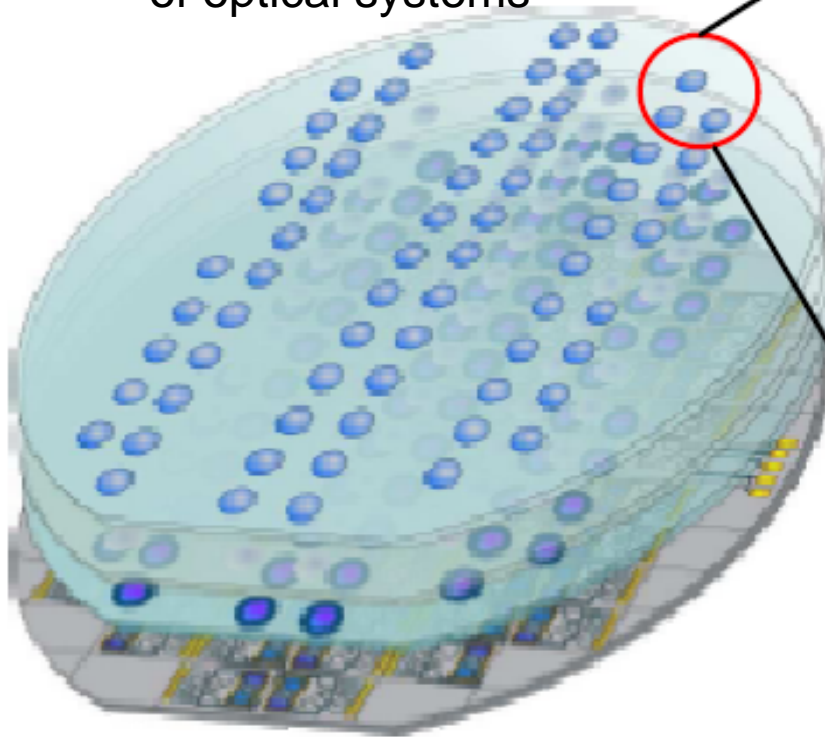
Application:

- Homogeneous illumination of a HDTV-Imager with 16:9 aspect ratio



Next step: wafer based manufacturing of high precision glass optics

Wafer based
assembly
of optical systems



Multi cavity array
for a-spherical lenses

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**The best way,
to master the challenges
of the future,
is to create them actively.**

Ο καλύτερος τρόπος να ανταποκριθούμε
στις προκλήσεις του μέλλοντος είναι να
τις διαμορφώσουμε ενεργά.

Fraunhofer PCCM – Joint Lab between Fraunhofer IPT in Aachen and CERTH in Thessaloniki



- Booth at the Hannover Fair April 2010
- Qualification procedures for high performance coatings

[Does work.mp4](#)





Does work!
Λειτουργεί!

**Fraunhofer IPT - CERTH
PCCM**



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