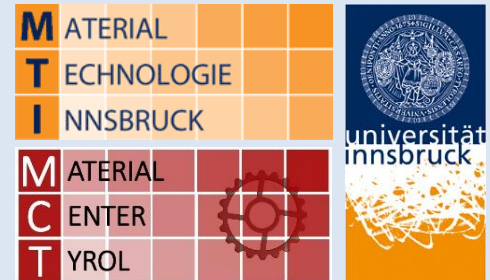


MCT – Material Center Tirol

Head: Dr. Georg Strauss



Scientific partners:

Universität Innsbruck, Fakultät der technischen Wissenschaften

Institut für Konstruktion und Materialwissenschaften

Arbeitsbereich: Materialtechnologie

Prof. Dr. Roman Lackner



The fascination of functional surfaces produced by thin film technology

- Presentation of MCT
- Typical applications and examples
- Functional surfaces
- PVD (Physical Vapour Deposition) technology
- Some realised examples

MCT - Material Center Tirol

Faculty of Technical Science at the University of Innsbruck
Institute of Construction and Material Science
Department: Material Science – Surface and Thin Film Technology

Material Technology

- Material characterisation
Mechanical properties
Transport properties
Thermal properties
- Material development
- Process optimisation
- Sustainability
damage mechanism
Recycling
Cycle of materials
- Measurement and Monitoring

Surface and Thin Film Technology

- PVD-Technologies
Magnetron-Sputtering: dc,dc-pulsed
Arc Source: dc,dc-pulsed
Gasflow-Sputtering
- Prozess- und Plasma Analysis
Plasmamonitoring
Langmuir-Sonde
Optical Emission Spectroscopy
Faraday Cup System
- Process optimisation
Efficiency, Stability, Reproduction,
Upscaling
- Target tests

Surface and Material Analysis - NanoLab

- Chemical analysis
- Material analysis
REM-EDX
IR Spectroscopy
XRS and XPS
- Porenraumanalytik
FIB-SEM Microscopy
Mass analytics
- Surface analysis
Infinite Focus Microscopy
AFM - Atomic Force
Nano- and Micro-Indentation

Modelling and Simulation

- Multi Scale Modelling
Optimisation of materials
Influence of parameters
- Simulation -
Numerical methods
Production process
Handling process
Damaging process
- Calculation tools
Prozessbegleitung
Qualitätssicherung
Schadensanalyse

Partners of MCT:

Institutes and facilities of University of Innsbruck
MCL - Material Center Leoben
PhysTech Coating Technology GmbH
Plansee SE
RHP Technology

Contact:

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Applied science and development in the field of Material science, Surface science and Thin film technology – Networking – UIBK – regional companies

Science and Technology service

Workout of technology questions and problems, Feasibility studies, small projects, networking

Industrial projects (typ. 1-3 years)

Specific scientific tasks and developments together with regional companies

Education

Integration of surface science and thin film technology into the university education: lectures, exercises. Practical exercises, seminars, workshops

Science and development

General scientific research and development, international scientific research projects

Functionalising of surfaces by PVD technologies

Thin films produced by PVD technologies
can show a lot of specific properties

⇒ from nm to μm

- ▶ they make tools hard and wear resistant
- ▶ they transmit, reflect or filter light
- ▶ they protect and decorate surfaces
- ▶ they isolate against heat or coldness
- ▶ they improve electric conductivity
- ▶ they realise diffusion barriers

Surface functions



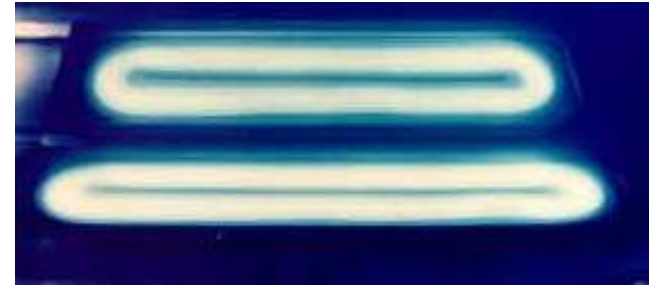
- ▣ Tribology
- ▣ Optics
- ▣ Surface protection
- ▣ Tools
- ▣ Medical Implantats
- ▣ Electronics

...

Applications



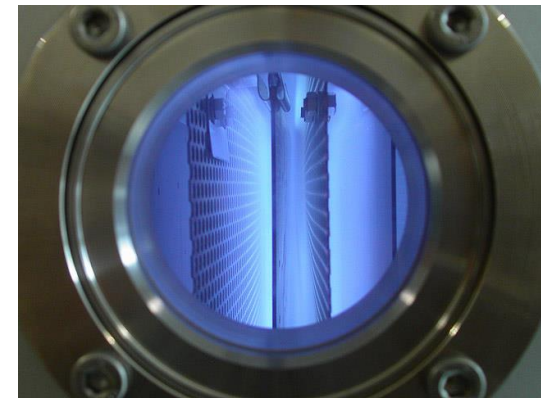
Activation of plastic parts



Magnetron sputter plasma for the deposition of optical thin films



PVD/PACVD
Hauzer – Batch Coater
Tools – Tribology – Surface protection



Cleaning of metal parts by plasma pre-treatments

Applications

Decorative hard coatings, e.g. TiN, TiAlN, CrN, CrON, TiC, DLC



Grey	Black	Gold	Red	Others
Stainless Steel	Anthracite	Gold 24K	Copper Rose	Flat Dark Earth
Nickel	Black	Gold 18K	Bronze	Sand
Smoked Grey	Black	French Gold	Brass	Rainbow

Applications

Pleuel Planflächen

- Pleuel für klassischen Boxer Motor
- Titan
- Verschleißschutz an den Planflächen
- Tribobond 30 CrN , 6µm
- 35.000 Stk 2014



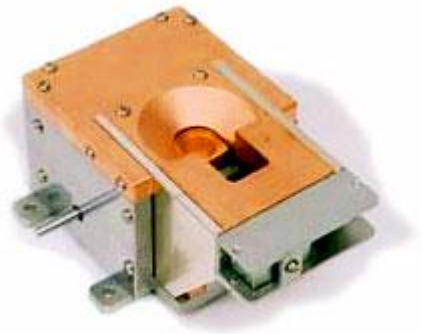
Coating material transfer mechanisms

Three fundamental mechanisms

Evaporation

Sputtering

Exploding Plasma Ablation



E-gun for evaporation



magnetron plasma

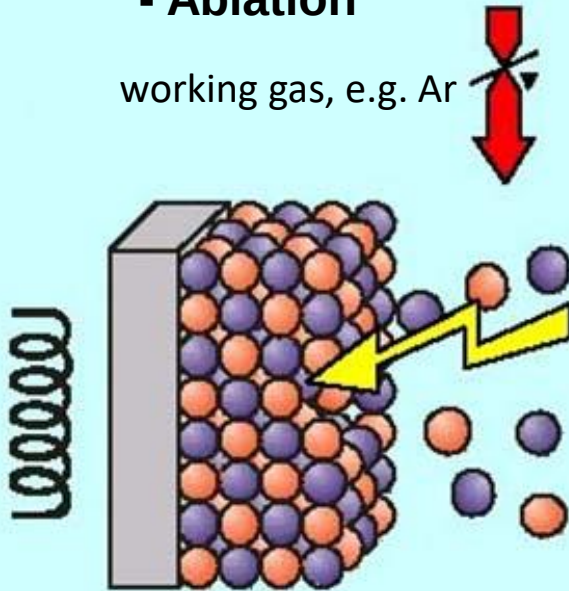


arc source deposition

PVD principles

Evaporation – Sputtering - Ablation

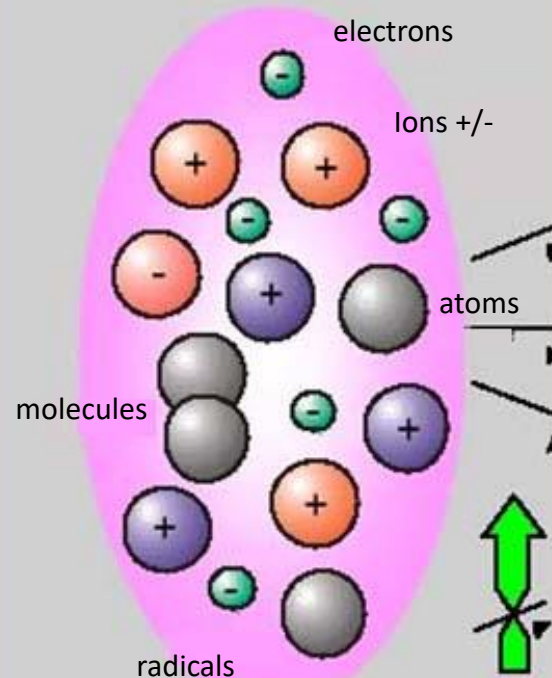
working gas, e.g. Ar



Starting material:

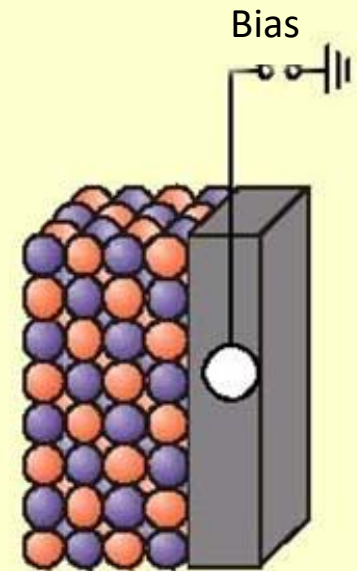
Targets, cathodes, granulate,
ingots, tabs

Transport of particles in the plasma



Gas phase:
Plasma

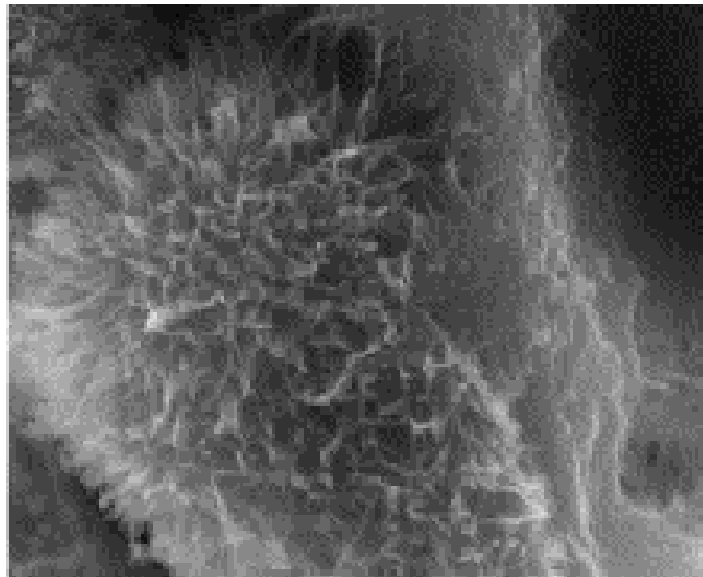
Condensation



Substrate:
Glass, metal, plastic

Material properties

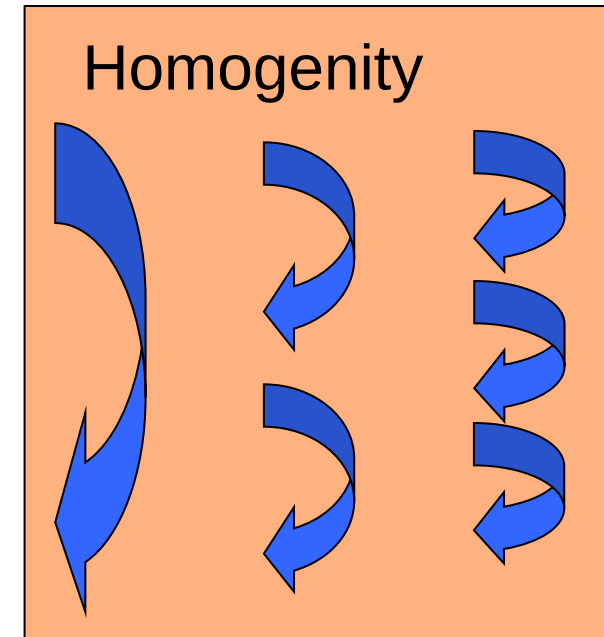
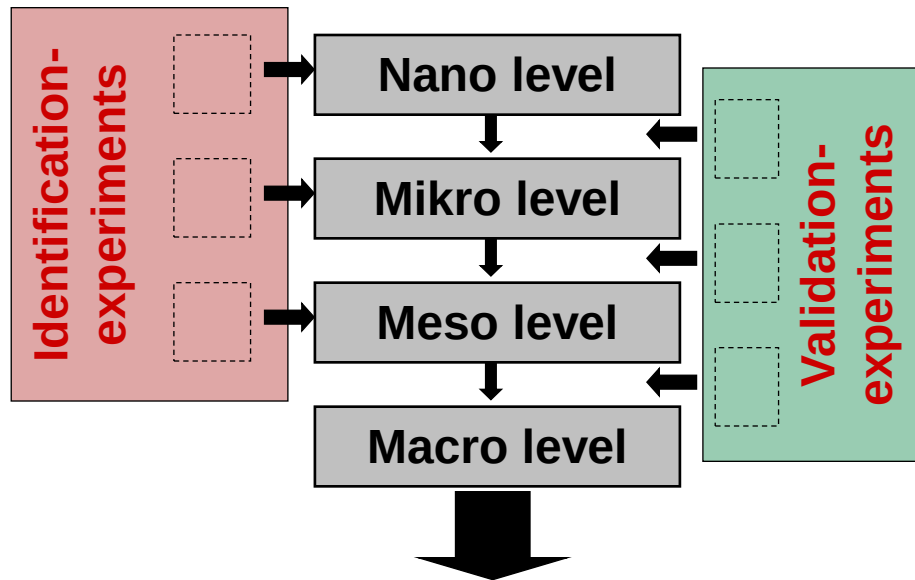
The material behaviour and material properties are a function of material composition and material structure



... dependent on production process
... dependent on time

Methology

Relationship and correlation of material properties with process parameters and material structure



Effective material and surface properties are input information for the simulation and modelling

Vacuum plants



Magnetron Sputter Coater (MCT)

Vacuum plants



Arc Source Deposition (PhysTech)

Vacuum plants



Gas-Flow-Sputtering (PhysTech)

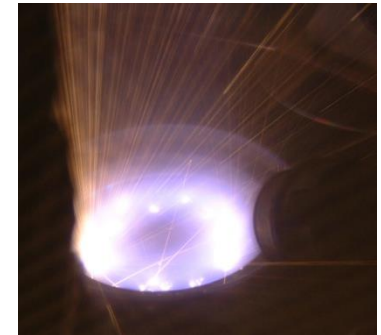
Vacuum plants

Industrial scale plants - IonBond



Research

- Development and optimisation of new materials
 - PVD process characterisation and plasma analysis
 - PVD process adaption: functionality, material, up-scaling
 - Test of process parameters and parameter fields
- WHICH parameters control WHICH PROPERTIES ?
- Reproducibility: long term stability of processes
 - New developments – tests
 - Production of prototypes

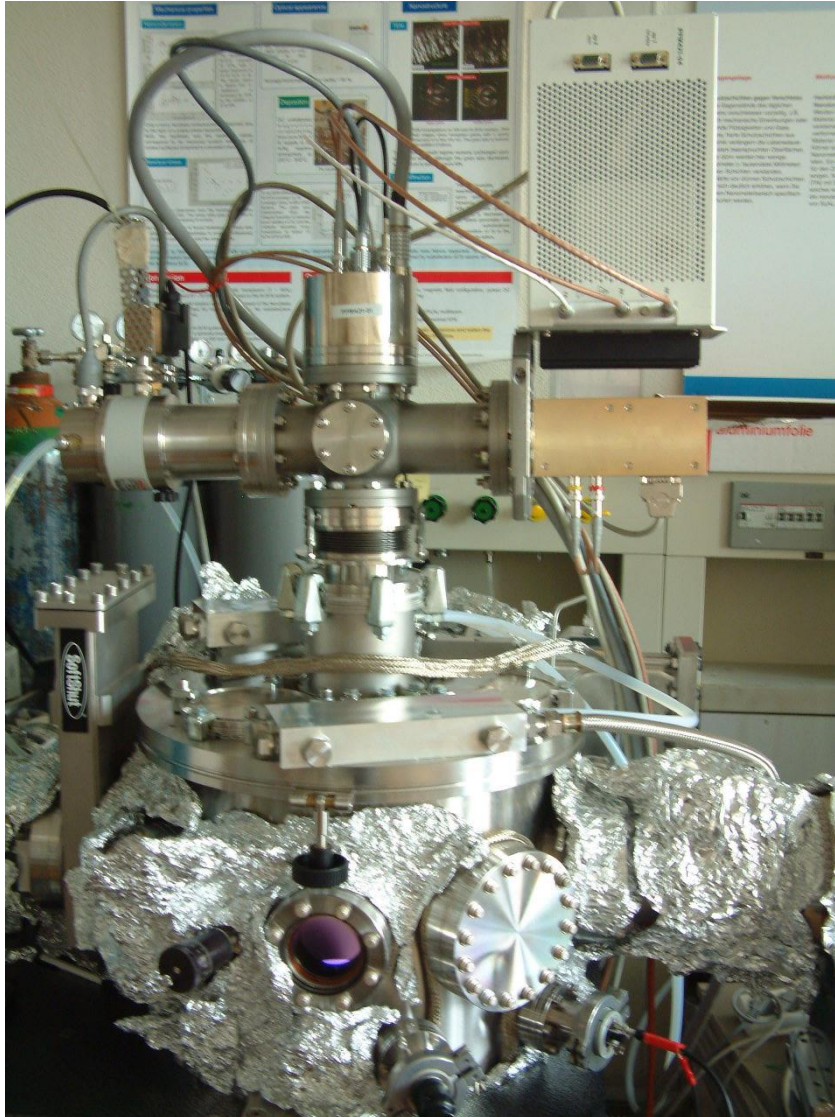


Limiting factors for customers:

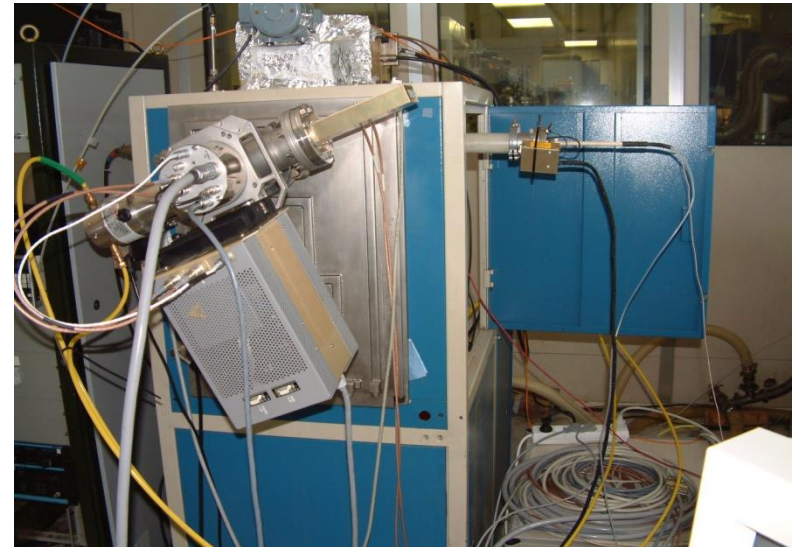
- Personal, Know-How
- Measurement systems for the process characterisation
- Different PVD technologies



Research

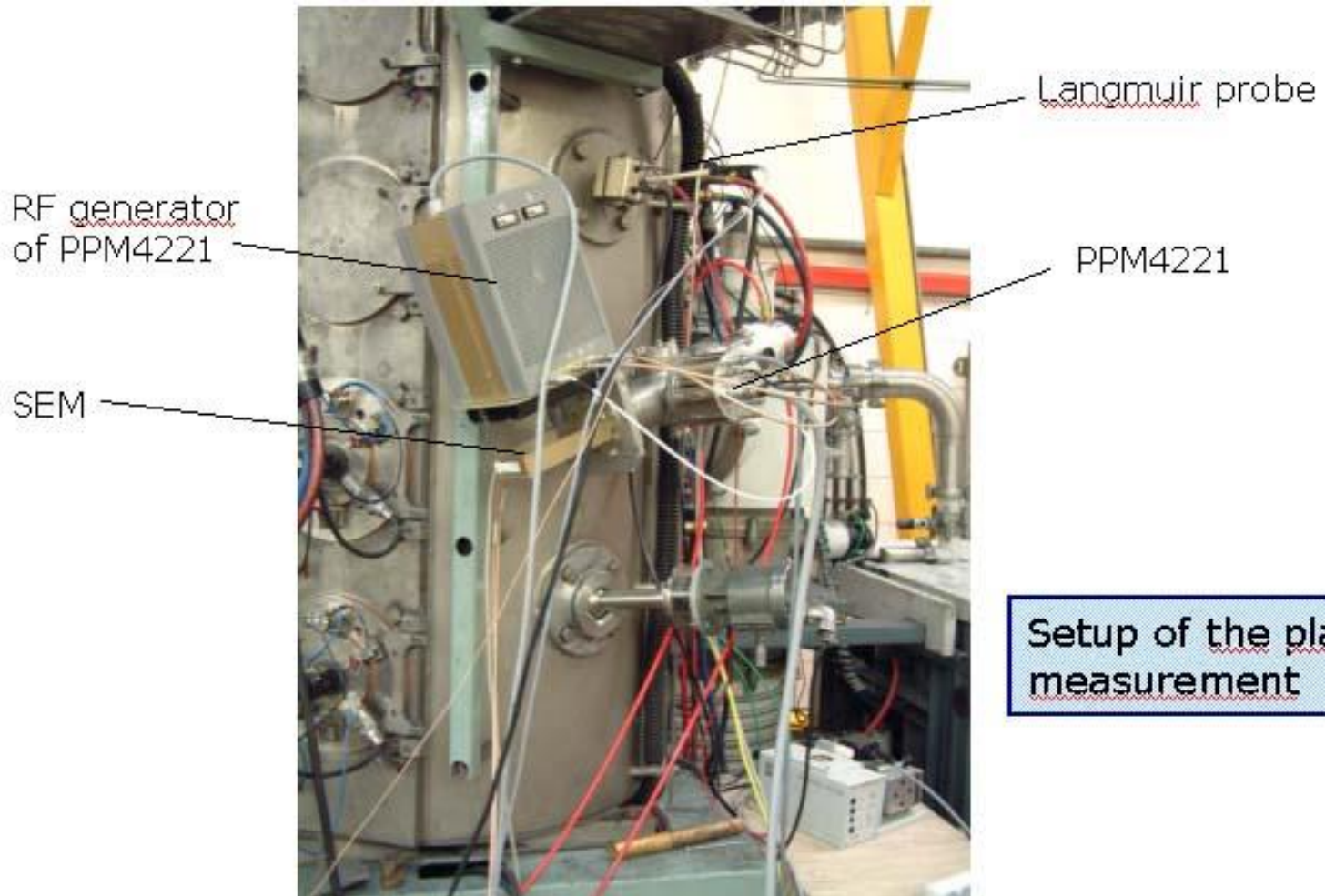


EMPA – Dübendorf (CH)



CeTeV – Carsoli (I)

IonBond – Newcastle (GB)



Aktuelle Forschungsprojekte und Kooperationen

- Interreg Projekt: ICAP - Certottica
Innovation durch kombinierte Anwendungen von Plasmatechnologien
- Kooperationsprojekt: ROLF
Dekorative und korrosionsbeständige Schichten für Brillengestelle
- Kooperationsprojekt: Sunplugged
Prozessentwicklung und Schichtanalytik für CIGS Photovoltaik-Zellen
- Machbarkeitsstudie: Stubai
Entwicklung von induktiven Härteprozessen - Materialanalytik
- Seminare, Workshops, Ausbildung
Uni Innsbruck, QualiMat, OTTI-Regensburg, EFDS
- Industrie-Dissertation: Plansee SE
Analyse und Modellierung von Mo Sputtertargets

Aktuelle Forschungsprojekte und Kooperationen

- **Industrierauftrag: PhysTech**
Test von dielektrischen Sputtertargets
- **Industrierauftrag: Swarovski**
Plasmacharakterisierung Ionenquelle
- **Industrierauftrag: Zimmer**
Schadensanalyse an Ventilbeschichtungen
- **Innovationsscheck: Pierre Delore**
Hartstoffschichten für Uhrengehäuse
- **Solar-ERA.net: Sunplugged**
Lösungen für die Langzeitstabilität von CIGS Solarzellen

Thank you for your attention

