10th International Symposium on
10th German-Japanese Symposium on

# nanostructures

Dear colleagues and dear All,

this is the 10th International | 10th German-Japanese Symposium on Nanostructures OZ-18.

We are now meeting for the sixth time in Germany and still we are focussing on making things smaller and increasing function and benefit at the same time.

Making more with less will determine our all success in being able to satisfy increased demands of more people still with the same not-growing resources. An intelligent design of materials, processes and products also decides if we will be successful in changing our entire economies to fully recycle-able ones. There is no waste on this planet ! There is material !

After the nanoTruck from the German Federal Ministry of Education and Research (BMBF) has been with us in 2012 and 2014 and not existing any longer during 2016, the BMBF-InnoTruck (inaugurated at HMI2017) will join OZ-18. Thus the Official Photo of OZ-18 will be taken outside at the lower plaza behind the Wenden townhouse - Monday 11:30 am.

Every year not at all a standard phrase but very much again we like to say “thank you very much !” to those, who made all this possible: our oral and poster speakers, our exhibitors and our attendees and last but not least at all, the diligent OZ-team and helping hands on site.

Let's start another global brainstorming to the benefit of mankind and planet.

*Thank you very much.*

*Monte Cassim, Sebastian Diaz, Henning Zoz, Jai Sung Lee, Hans Fecht & Detlef*

OZ-symposia in the past have been supported by the Ritsumeikan Global Innovation Research Organization (R-GIRO) Project and the Grant-in-Aid for Scientific Research on Innovative Area, "Bulk Nanostructured Metals", through MEXT, Japan.

OZ-symposium today is kindly supported by the European Academy of Sciences and Arts, by the German Federal Ministry of Economic Affairs and Energy as well as the Korean Powder Metallurgy Institute.


**64 presentations from 19 countries**
**35 exhibitors from 11 countries**

Argentina, Austria, Czech Republic, China, Germany, India, Israel, Italy, Japan, Korea, Mexico, Netherlands, Poland, Russian Federation, Serbia, Spain, Sweden, Taiwan, USA

# [OZ-18]

## 10th International | 10th German-Japanese Symposium on Nanostructures

*March 4-6, 2018*
*Wenden, Germany*




BMBF-nanoTruck does not exist any longer, welcome BMBF-InnoTruck !
(see back-coverpage)

**Address for the 10th International I 10th German-Japanese Symposium on Nanostructures, March 4-6, 2018 in Wenden, Germany**

Innovation and technology are changing the world and everyone's lives. Many things that used to sound very futuristic have become part of our daily life. And there is a possibility that much of it will soon be overtaken by even newer developments.

If we want to remain competitive, and if we want to create growth, prosperity and jobs in the long term, we need to invest in research, innovation, and in training skilled professionals.

The Federal Ministry for Economic Affairs and Energy is fostering Germany's innovation capacity by creating a positive environment for investment, and by providing funding programmes that are targeted to the needs of the market.

We want Germany to continue to be a global leader on innovation and future technologies, not only today, but well into the future.

This April, I presented an innovation agenda that focuses on technology-neutral funding. This will give companies the freedom they need to decide what technologies they want to invest in.

We also want to place a stronger focus on strategic sectors and forward-looking technologies. These include micro-electronics, nanomaterials, artificial intelligence, biotechnology and quantum technology.

We need bright minds and people who think out of the box - people who are creative and full of ideas that will carry this country to success. This also means bringing in talent from outside Germany. Only if people from around the world work together can we achieve the best results.

The motto of the International Symposium on Nanostructures is: How can I do more with less material.

The Federal Government and the Federal Ministry for Economic Affairs and Energy have been supporting this symposium - which was first held ten years ago - for many years.

The meeting is truly international. At last year's symposium, which was held in the town hall of Wenden in Germany, a total of 18 nations took part.

The fact that there is so much interest in this conference from around the globe shows that modern materials and strategies for the development of sustainable materials and products are the key to future competitiveness.

I wish you the best of success for the symposium, and hope that your discussions will be fruitful, and that you will take away many new ideas and some good inspiration.

*gez./gespr. Bundesministerin Brigitte Zypries*

**Brigitte Zypries**
Federal Minister for Economic Affairs and Energy

Federal Ministry
for Economic Affairs
and Energy

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The European Union not only stands for one of the longest periods of peaceful living together of numerous different nations but also for strong joint and successful undertakings for the maintaining and continued expansion of wealth among their members and neighbors.

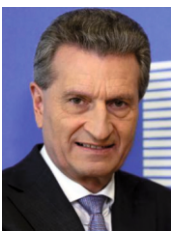
Naturally, the growth of wealth can only go along with a growth in caring for nature and environment, our all place to live. Finding the balance of economy and ecology is the key where a strong, innovative and as clean as possible industry contributes the funds and benefits the business environment at the same time. In our successful society model, wealth requires manufacturing.

Energy and Information are among the most important factors for providing an excellent platform for all, living & pleasure and manufacturing & business.

Respecting the limited resources of our planet, materials represent a critical part. Since we understand to require more materials for more products, more energy and more service in the future, there are two goals that must be followed: we have to care responsible for the resources we have, which means we better use rather consume material which ends in the obligation of ultimate recycling. Before we bring a product to the market, we need to know what to do res. how to re-use after its lifespan. The second major challenge is to improving the utilization of all particular resources - and that for materials means that we need to generate more functionality, more application and more sustainability with less material. This guides into smaller functional units leading from e. g. micro-materials to nano-materials and in the future maybe even pico-materials.

The already 10th Symposium on Nanostructures provides, insofar already since 10 years a platform for global information exchange on an important field of innovative materials close to application and we welcome this organization and every single attendee coming together for contributing new ideas for the benefit of mankind and a better quality of life today and in the future.

I wish you all a successful meeting and great efforts in providing small but important steps for new solutions in materials and application.



**Günther Oettinger**
Commissioner of the European Union

**Address for the 10th International I 10th German-Japanese Symposium on Nanostructures, March 4-6, 2018 in Wenden, Germany**

The medical technology company Ottobock HealthCare is a global market leader in Prosthetics, Orthotics, Mobility Solutions and MedicalCare with more than 6.000 employees and a history of 100 years in 2019.

Ongoing success and growth goes along with technological innovations to the benefit of our customers. As for the future strategic development projects, Ottobock's research and development focuses on:

(a) providing mechatronic solutions for further components for auto-adaptive control where the "electronic intelligence" of the product itself helps the user by adapting to different conditions and everyday situations automatically;

(b) further development of materials with an ongoing focus on lightweight, biocompatibility, energy storage and in vivo generation in order to increase comfort and life-quality for complex solutions such as the carbon-fibre-based feet;

(c) achieving better osseointegration for the mounting of prosthesis systems to the long bone via implants where e. g. the risk of infection at the site where the skin is penetrated must be minimized by new coatings and materials;

All defined areas are dealing directly or are depending on materials. Thus also Nanotechnology and materials improved in functionality and properties on nanoscale are most important to Ottobock in practically all areas of future innovations. Particularly for health-care, further miniaturization, multi-functionality and sustainability are major goals to helping and supporting the human body.

In the 1950s, Ottobock was the pioneer for substituting wood for prosthetic components by polyurethane plastics and today is using myoelectrics for prostheses where low electric voltages by human muscle contracts are measured on the skin, amplified and utilized as control signals for artificial joints. For the future it can only be assumed, what new materials along with new technologies and innovations can provide to a better quality of life, more mobility or independence to the user.

In this mission we are aware of the Symposium on Nanostructures over the last years also by attending and contributing and we do welcome the impressive interdisciplinary exchange of the latest findings, ideas and visions by science and industry from almost all the world. The Symposium on Nanostructures will again make an important contribution to this. And since the upcoming event will be the 10th to be held, it is my pleasure to wishing all of the participants a good and successful event at Wenden with good interactions, many new ideas and new solutions.

*gez. Prof. Näder*

**Prof. Hans Georg Naeder**
Chairman of the Management Board Ottobock HealthCare

ottobock.

**Address for the 10th International I 10th German-Japanese Symposium on Nanostructures, March 4-6, 2018 in Wenden, Germany**

Applied research takes place in a rapidly changing environment in which political factors, market trends and technologies are in constant evolution. The major part of technological challenges are related to materials. Innovative materials are one key to success. Nanotechnology and related topics such as nanostructures are cutting-edge technologies which will serve many applications in the future. In order to face the challenges such as rising competition, product development processes and life cycles becoming shorter and shorter, as well as the emergence of ambitious new global markets, the need for international cooperation has become more obvious. Undoubtedly, Japan is one of the leading countries in the various fields of nanotechnology. In fact, Japan´s overall focus on innovation and technology is very similar to that of Germany and despite the geographical distance, Germany and Japan have much in common. Both are leading high-tech nations with excellent economic and scientific infrastructures and where a sophisticated culture of engineering is firmly established. Uniting the competences of both countries presents the chance to create excellent results and a wider range of opportunities. This is also the reason why Fraunhofer has been cooperating with Japanese partners for decades and the intensity of collaboration is today higher than ever. This is also the reason why 80 percent of the Fraunhofer Institutes are active in Japan, and it is among the four most important countries in terms of international revenues.
Many Fraunhofer Institutes have been doing research in different fields of nanotechnology. Nearly one third of all Fraunhofer Institutes are members of the Fraunhofer Nanotechnology Alliance and active in this field. Three researchers of the Fraunhofer Institute for Ceramic Technologies and Systems IKTS won one of this year´s Joseph-von-Fraunhofer-Awards - an internal yearly award for excellent scientific performance for Fraunhofer researchers - for the development of a ceramic nano filtration membrane for the purification of waste water. A team of researchers of the Fraunhofer Institute for Laser Technology ILT and RWTH Aachen University was awarded with another of this year´s Joseph-von-Fraunhofer-Awards for the development of a high speed laser welding contract that, for the first time, offers an economic alternative to the use of hexavalent chromium. The Fraunhofer Institute for Manufacturing Engineering and Automation IPA has a close collaboration with The National Institute of Advanced Science and Technology (AIST) in Japan in the field of electroactive polymers in the form of a Fraunhofer Project Center at AIST Kansai.

The 10th Symposium on Nanostructures is a wonderful opportunity for exchange and networking among top experts in the field. Over the last decade it has established itself as a tradition and hub for the transfer of knowledge and experience. I support and look forward to the future of this important event and wish you all an inspiring and successful conference.

**Prof. Dr. Reimund Neugebauer**
President of Fraunhofer-Gesellschaft

Fraunhofer

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Dear participants of the Nanostructures Symposium at Wenden. A warm hello on behalf of Lamborghini and especially from my side. I would like to thank Dr. Henning Zoz for the kind invitation, which, much to my regret, I had to decline due to an overlapping with the Geneva auto show. This is just - see you soon - because innovation is in our DNA and I can anticipate that we are currently investing in a research with the MIT on carbon nanostructure application. And we would be proud to share the outcome, soon. In the meantime, I wish you all the best for a successful event.

*gez./gespr. Paolo Poma*


Scan QR-code to find video.

**Paolo Poma**
CFO & General Manager, Automobili Lamborghini S.p.A.

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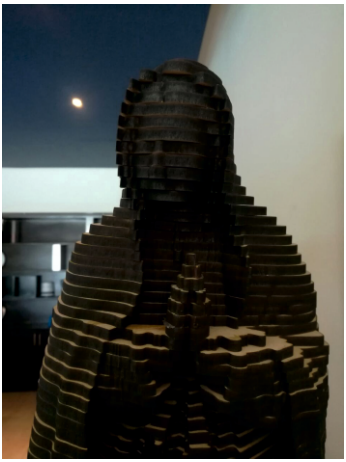


The Virgin of Guadalupe Project: a statue made with High Performance Concrete, 47m high at Guadalupe, Zacatecas

Scan QR-code to find video.

**H. E. Alejandro Tello Cristerna**
Governor of Zacatecas

# Schedule

| time/day | **Sunday, March 04, OZ-18 arrival day** | | location |
|---|---|---|---|
| 14:15-18:00 | board meeting Metallurgy Europe | | ZTC R1/2 |
| 14:15-18:30 | exhibition set-up, info desk and registration at conference site | | expo-area |
| 18:30-21:00 | welcome reception | | |

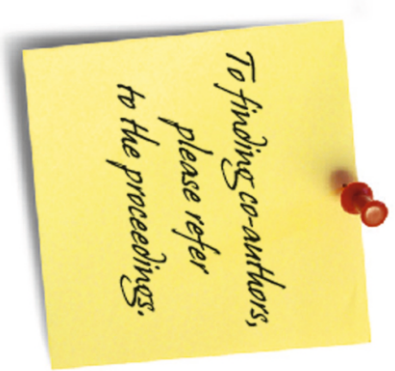
| time/day | **Monday, March 05, OZ-18 day 1** | presentation | location |
|---|---|---|---|
| 08:00-10:00 | exhibition set-up, registration at the conference site | | expo-area |
| 10:00-11:30 | welcome & concert | W01-05 | auditorium |
| 11:30-12:00 | coffee-break, exhibition & posters - Official Photo of OZ-18 | all Posters | expo-area |
| 12:00-12:45 | session 01 (ceremonial lecture) | CL-T | auditorium |
| 12:45-13:30 | lunch, exhibition & posters | all Posters | expo-area |
| 13:30-14:45 | session 02 | V01-03 | auditorium |
| 14:45-16:00 | session 03 | V04-06 | |
| 16:00-16:30 | coffee-break, exhibition & posters | all Posters | expo-area |
| 16:30-17:45 | session 04 | V07-09 | auditorium |
| 17:45-18:30 | session 05 | V10-11 | |
| 18:30-20:00 | excursion 01 | | ZTC |
| 18:30-20:00 | coffee-break, exhibition & posters | all Posters | expo-area |
| 20:00-22:00 | meet`n`greet party, cultural program, serendipity presentation | CL-W | |
| 22:00-23:00 | bus-transfer to hotel operated | | |

| time/day | **Tuesday, March 06, OZ-18 day 2** | presentation | location |
|---|---|---|---|
| 08:00-10:00 | exhibition set-up, registration at the conference site | | expo-area |
| 10:00-11:30 | session 06 | V12-14 | auditorium |
| 11:30-12:00 | coffee-break, exhibition & posters | all Posters | expo-area |
| 12:00-12:45 | session 07 | W06, V15-16 | auditorium |
| 12:45-13:30 | lunch, exhibition & posters | all Posters | expo-area |
| 13:30-14:45 | session 08 | V17-19 | auditorium |
| 14:45-16:00 | session 09 | V20-22 | auditorium |
| 16:00-16:30 | coffee-break, exhibition & posters | all Posters | expo-area |
| 16:30-17:45 | session 10 | V23-25 | auditorium |
| 17:45-18:30 | coffee-break, exhibition & posters | all Posters | auditorium |
| 18:30-20:00 | excursion 02 | | ZCS |
| 18:30-20:00 | coffee-break, exhibition & posters | all Posters | expo-area |
| 20:00-21:00 | reception at ZCS | | ZCS |
| 19:00-21:00 | exhibition turn-down | | expo-area |

## [OZ-18 post conference days]

Nanotun3d-Day | Guadalupe project | HPC/UHPC large scale demonstrations

## Wednesday March 07




10th International Symposium on
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# Presentations

auditorium

# Session Chairpersons to OZ-18

## Session 02

**Fraunhofer HQ, Munich**
**R&D Contracts and IPR**

Dr. Lorenz Kaiser
Division Director R&D Contracts and IPR

## Session 03 & 04

**Airbus, Ottorunn**
**Group Innovations**

Dr. Blanka Lenczowski
Senior Expert Material Technology

## Session 05

**KPMG Luxembourg**
**Société coopérative**

Dr. Sven Muehlenbrock
Partner, Head of Risk Advisory

## Session 06

**Rusnano, Moscow**
**Board of Directors**

Prof. Dr. Sergey Kalyuzhnyi
Director, Chief Scientist

## Session 07

**CIITEC-IPN**
**México City**

Prof. Dr. Sebastián Díaz de la Torre
Director

## Session 08 & 09

**SmartMembranes GmbH**
**Halle, Germany**

Dipl.-Chem. Monika Lelonek
Managing Partner

## Session 10

**Fraunhofer-IPA, Stuttgart**
**Dept. for Functional Materials**

Dipl.-Ing. Ivica Kolaric
Department Manager

| | | | | | | |
|---|---|---|---|---|---|---|
|  |  |  |  |  |  |  |
| Fraunhofer | AIRBUS | KPMG Luxembourg | RUSNANO | IPN CIITEC | smart MEMBRANES | Fraunhofer |
| S02 | S03+S04 | S05 | S06 | S07 | S08+S09 | S10 |

# Welcome Session| 10:00 - 11:30

W01 **[Welcome to OZ-18, Welcome to Germany]**

| | | | |
|---|---|---|---|
| **City of Wenden**<br>Germany | **Bernd Clemens**<br>Major | | |
| **Zoz Group** | **Prof. Dr. Henning Zoz** | | |
| **Federal Ministry for Economics & Energy**<br>Berlin, Germany | **Brigitte Zypries**<br>Federal Minister<br>[video-message] | | |

W02 **[Welcome to our only Planet Earth, Welcome from Kazakhstan]**

| | | | |
|---|---|---|---|
| **United Nations**<br>Honorary Senior Fellow<br>Potsdam, Germany | **Prof. Dr. Klaus Töpfer**<br>Federal Minister a. D. | | |
| **Embassy of Kazakhstan**<br>in Germany<br>Berlin, Germany | **H. E. Bolat Nussupov**<br>Ambassador | | |

W03 **[Welcome from Guadalupe, from & to Zacatecas]**

| | | | |
|---|---|---|---|
| **Municipal de Guadalupe**<br>Guadalupe, Mexico | **Sen. Enriques Flores Mendoza**<br>President, Major<br>*[co. Prof. Sebastian Diaz]* | | |
| **State Government of Zacatecas**<br>Zacatecas, Mexico | **H. E. Alejandro Tello Cristerna**<br>Governor<br>[video-message] | | |

W04 **[Welcome from & to Korea, Welcome to Aerospace]**

| | | | |
|---|---|---|---|
| **Hanyang University**<br>ERICA<br>Seoul, Korea | **Prof. Dr. Jai-Sung Lee**<br>Dist. Prof., Vice President a. D. | | |
| **Airbus**<br>Bremen, Germany | **Dr. Detlef Müller-Wiesner**<br>Senior Vice President | | |

W06 **[Welcome from Japan & Sri Lanka, Welcome to EUREKA]**

| | | | |
|---|---|---|---|
| **Ritsumeikan University**<br>Shiga, Japan & Colombo, Sri Lanka | **Prof. Dr. Monte Cassim**<br>Advisor to the President<br>[starts Session 07] | | |
| **Ulm-Uni & EUREKA**<br>Metallurgy Europe<br>Ulm, Germany | **Prof. Dr. Hans Fecht**<br>Director<br>[starts Session 07] | | |

W05 **[Welcome to SuperCars, Welcome from Taiwan]**

| | | | |
|---|---|---|---|
| **Automobili Lamborghini**<br>S.p.A.<br>Sant'Agata Bolognese, Italy | **Paolo Poma**<br>CFO & Managing Director<br>[video message] | | |
| **Taipeh Representation** in Germany<br>Berlin, Germany | **S. E. Prof. Dr. Ihy-Wey Shieh**<br>Ambassador | | |

HoD forming

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**Solar Applied Materials Technology Corp.**
Tainan, Taiwan

**Dr. Chien-Yung Ma**
Chairman

## The Key and Solution for Sustainable Development in Industry : Recycle Wastes Into Resources via Green Process

Over the past 30 years, Taiwan has made a significant progress in the industries of semiconductor and opto-electronics as well as micro-electronics in terms of business models of OEM and ODM. However, a various of electronic wastes or scrapes were also generated which have caused a different kinds of pollutions to the environments of society. The same is true in our planet when a number of electronic products are being used and discarded after the end of life in the whole world and the situation is getting worse and worse. It is reported that more than 60 million tons of electronic wastes is produced annually which are seriously contaminating and damaging our earth. As a recycler and refiner, Solar Applied Materials Technology Corp. has been developing various green technologies to recycle the valuable materials from electronic wastes to solve the issues of existing processes with cyanides or strong acids. It is believed that the circular economy developed via green process for all kinds of wastes is expected to be widely introduced and applied globally in order to transfer scraps into resources, not only for industry applications, but for environmental protection.

V01

**Oak Ridge National Laboratory - ORNL**
**Materials Science & Technology Div.**
Oak Ridge, TN, USA

**Prof. Dr. David T. Hoelzer**
Senior Research Scientist

### Nanostructured Ferritic Alloys for Advanced Nuclear Reactors

Much excitement arose in nuclear energy research communities around the globe with the discovery of nanostructured ferritic alloys (NFA) at the beginning of the 21st century. NFA's evolved from oxide dispersion strengthened (ODS) alloys, which have been around for many decades, due to refinement in the microstructure consisting of an ultra-fine grain structure and high concentration of nano-size (~2-5 nm) oxide particles. Many studies have demonstrated that NFA's possess remarkable high-temperature strength resulting in outstanding creep performance combined with very low swelling rates and less hardening during exposure to high-dose irradiations. This presentation will cover the goals of the US DOE's Nuclear Technology Research and Development Program's Advanced Fuels Campaign that emphasizes understanding fabrication methods for producing thin wall tubing, including studies dealing with recrystallization, texture and plastic deformation, joining thin components by friction stir welding and the response of microstructure and mechanical properties of NFA exposed to neutron irradiation.

V02

**Nuclear Research Centre Negev - NRCN**
**Israel Atomic Energy Commission**
Be'er Sheva, Israel

**Dr. Ori Yeheskel**
Senior Research Scientist

### Methodology for Maturity Evaluation of Powder Bed Additive Manufacturing Based on MRL and NDE

Manufacturing Readiness Level (MRL) methodology goes hand in hand with Technology Readiness Level (TRL). The equipment for Additive manufacturing (AM) is in a maturity level of TRL 8 where growing number of machines are sold yearly worldwide. However, the maturity of 3D printed objects is lower in the MRL scale, as low as MRL 5. In this talk we shall show mechanical properties and microstructure of metal objects (Ti6Al4V as a model material) that indicate their sensitivity to processing. Hereafter we describe a methodology that is being developed to expedite and verify the maturity of 3D printed metal objects. The methodology includes verifying the quality of personnel, characterization of raw materials combined with study of the "powder-processing-microstructure-properties and performance", PP-M-PP, relationships. Some material properties are measured using ex- situ non-destructive evaluation (NDE) but in-situ NDE methods, like Layer Cam™ are sought and will be employed in the future. Current NDE is based on analyzing the interaction of sound waves with the microstructure which is studied by metallography accompanied by neutron diffraction at the Los Alamos National Laboratory (LANL).

V03

**IME - Fraunhofer-Institute for Molecular Biology & Applied Ecology**
Münster, Germany

**Dr. Christian Schulze Gronover**
Group leader

### Plant-derived isoprenes for technical applications

Plants produce a plethora of specialized metabolites whereas many of them are synthesized using the C5 molecule isoprene as basic building block. Activated isoprene is converted into vitamins, defense compounds, flavorings or polymers. To date, most of the world's isoprene for chemical and pharmaceutical industries is made via separation from the petrochemical C5 stream. Some of the major challenges facing the isoprene market include sufficient supply, future shutdowns and increasing price whereas accessing isoprene is already very capital intensive. Thus, alternatives for the production of isoprene and isoprene-derived substances are urgently needed.
The presentation will give an overview on our research about the production of high valuable isoprene derived substances for industrial use. Different technologies will be presented e.g. use of plant organ cultures and microbial isoprenoid production and conversion.

*(shortened - pls. see proceedings)*

V04 **Karlsruhe Institute of Technology - KIT**
**Institute for Applied Materials**
Karlsruhe, Germany

**Prof. Dr. Anton Möslang**
Director

### ODS Steels for Energy Technology

Oxide dispersion strengthened (ODS) steels are promising materials for high temperature applications due to their superior creep and oxidation resistance at high temperatures. Origin of these outstanding properties are homogenously distributed, nanoscaled (< 4 nm) oxide particles. While in past years ferritic ODS steels were well-studied, austenitic variants (AODS) are expected to exhibit even better high temperature properties due to their close-packed, face-centered cubic (fcc) lattice. Based on the implementation of a two-step milling process and the use of a suitable process controlling agent it was possible to overcome completely to usual difficulties of AODS steel alloy fabrication and to produce sheets and extruded tubes with excellent ductility and long-term high temperature stability even at 1100 °C. Regarding nanoscaled ferritic-martensitic ODS steels, for the first time results are presented showing not irradiation degradation but substantial lifetime increase after high dose neutron irradiation. For both types of ODS steels correlations are made between strengthening, fatigue lifetime and fracture behavior on the one hand and microstructure evolution on the other hand. The results confirm, that advanced nanoscaled ODS steels have the potential to substantially increase the efficiency or lifetime of components exposed to extreme loadings, both in nuclear and non-nuclear applications.

V05 **Dr. Wilhartitz Co.**
Moscow, Russian Federation

**Dr.-Ing. Peter Wilhartitz**
Consultant

### Requirements of the Russian Industry for High-tech alloys and Perspectives for their Application in Additive Manufacturing

During the last decade additive manufacturing has achieved a steeply rising level of attention amongst high-tech companies in Russia. The equipment basis is significantly increasing every year with practically all equipment imported mainly from EU and US manufacturers.
Until now, due to a lack of domestic production most of the metallic powders need to be imported. In case of standard steel powders this approach is working well, but for high tech applications such as aviation industry, space and satellite components as well as turbine industry imported powders do not comply with the Russian standards.
Moreover, the Russian market is fractionated with many specialized companies that have created their specific alloys. Thus an investment in atomizing plants is not economic. The Simoloyer® provide an unmatched alternative to solve this problem. The technology is fully scalable from the level of few kilograms to several ton and provides the flexibility to produce any special alloy according to existing and future specifications.

*(shortened - pls. see proceedings)*

V06 **Quintus Technologies AB**
Västeras, Sweden

**Dipl.-Ing. Laurenz Ploechl**
Business Development Manager
AMD (DACH)

### Hot Isostatic Pressing - latest Equipment and Process Technology for Combined HIP / heat treatment of PM/AM Materials

Hot Isostatic Pressing (HIP) is a well-established compaction and densification process for PM materials and has been used traditionally in tool steels, tungsten carbides, duplex steels, intermetallic TiAl, precious metals, sputtering target alloys and ceramics for powder consolidation and final material densification, but also in more recent PM-materials/processes such as MIM and AM. This presentation will give an overview of the advances in equipment technology - enabling maximum payloads of Ø2m/50MT in the largest HIP units today - as well as advances in process technology - enabling integrated HIP and HPGQ (high pressure gas quenching) cycles for reduction of direct costs, overall throughput time, lean processes and enhanced material properties. Case studies of PM and AM materials will be provided.

V07

**German Armed Forces**
**BAAINBw / WIWeB (Bundeswehr)**
Erding, Germany

**Dr.-Ing. Jens Holtmannspötter**
Coordinator for Additive Manufacturing

### Nanotechnology adhesive bonding for carbon fiber reinforced plastics (CFRP) in aerospace structures - mission (im)possible ?

Structural adhesive bonding of CFRP is of great interest for future lightweight aerospace constructions. Due to previous incidences followed by increased certification hurdles, the goal seems to be far out of reach. The Achilles heel of adhesive bonds is the adhesion itself and there is and there will probably be no non-destructive testing method (NDT) to test the quality of the adhesion achieved within a bond. In consequence, aircraft manufacturers are neglecting to use the weight saving potential of adhesive bonding.
This contribution will give an example of a highly reliable (and therefore robust) adhesive bonding process. From the author's point of view, the key element of reliable adhesive bonding is proper surface treatment. In this talk, we summarize and discuss current results from our research on surface treatment, ageing and destructive testing of bonded CFRP joints. Based on these results a military aerospace demonstrator (airbrake) was fabricated and qualified, including flight trials to demonstrate the feasibility of reliable adhesive bonding processes.

*(shortened - pls. see proceedings)*

V08

**Fraunhofer Institute for Silicate Research - ISC**
**Project Group Materials Recycling and Resource Strategies, IWKS**
Alzenau, Germany

**Dr. Carsten Gellermann**
Head of Division Secondary Raw Materials

### The potential of mechano-chemical treatment for the recovery of resources from mineral residues

Global industries like the steel, iron and aluminum industry produce different dusts, sludges, ashes and slags on a day-to-day basis. These material systems have in common that they are constantly produced in large quantities (million tons per day) and contain a number of interesting resources. These resources - mostly metals - are usually embedded in an oxide or silicate matrix with a good chemical stability. In order to allow an economical feasible extraction of these metals, mechano-chemical leaching and subsequent selective recovery is a promising path.
The talk gives an introduction into the exciting field of mechano chemistry highlighted by practical examples from diverse projects.

V09

**Helmholtz-Zentrum Geesthacht - HZG**
**Helmut-Schmidt-University - HSU**
**University of the Federal Armed Forces at Hamburg**
Geesthacht & Hamburg, Germany

**Dr.-Ing. Julian Jepsen**
Materials Research Scientist and lecturer

### Technical and Economic Evaluation of Hydrogen Storage Systems based on Nanostructured Light Metal Hydrides

Novel developments regarding materials for solid-state hydrogen storage show promising prospects [1, 2]. These complex hydrides exhibit high mass-related storage capacities and thus great technical potential to store hydrogen in an efficient and safe way. However, a comprehensive evaluation of economic competitiveness is still lacking, especially in the case of the $LiBH_4$ / $MgH_2$ storage material. In this study, an assessment with respect to the economic feasibility of implementing complex hydrides as hydrogen storage materials is presented. Furthermore, the properties of $LiBH_4$ / $MgH_2$, so-called Li-RHC (Reactive Hydride Composite), are scientifically compared and evaluated on the lab and pilot plant scale. To enhance the reaction rate, the addition of $TiCl_3$ is investigated and high energy ball milling is evaluated as processing technique. The effect of the additive in combination with the processing technique is described in detail. Finally, an optimum set of processing parameters and additive content are identified and can be applied for scaled-up production of the material based on simple models considering energy input during processing.

V10 **RHP-Technology GmbH**
Seibersdorf, Austria

**Dr. Erich Neubauer**
Managing Director

### Additive Manufacturing of Large Metallic structures using blown powder processes

Whenever thinking about additive manufacturing for metals, it is very often a powder bed combined with a laser or electron beam system, that comes into ones mind. A very promising system for large parts (>1m) is based on a blown powder method. A plasma transferred arc system is used as a heat source in combination with powder feeding allowing the combination of materials, e.g. to realize multi-materials or composite materials.
The process will be described in detail and examples of different materials such as Titanium alloys, Iron based alloys as well as Nickel based alloys will be presented. Material properties, application areas as well as the potential of the technology will be presented.

V11 **3D PRO - 3D Printing Research Organization**
Changwon City, Republic of Korea

**Dr. Min Cheol Kang**
Executive Director

### The Strategic Opportunities of Metal Powder for an Additive Manufacturing Age

Additive manufacturing (AM), widely known as 3D printing, is a method of manufacturing that forms parts from powder, wire or sheets in a process that proceeds layer by layer using 3D model data.
AM has grown up from the early days of rapid prototyping, and as a dynamic field of study has acquired a great deal of related and redundant terminology. AM could revolutionize many sectors of manufacturing by reducing component lead time, material waste, energy usage, and weight saving. Furthermore, AM has the potential to enable novel product designs that could not be fabricated using conventional processes. However, there are too many disadvantages and rationales in metal AM for mass production. In order to meet the demand of new high performance alloys and overcome technical challenges, there has been active research at a number of universities, research institutes and industries to develop the next AM materials, bionical design and processing technologies.
This review presents current status of metal AM technologies, fabrication and market prospect of metal powder and challenges of metal applications for industries. Perspective on future strategic research opportunities are also presented for an Additive Manufacturing Age.

## Technical Excursion No.1 heading to ZTC

# Zoz Technology Center

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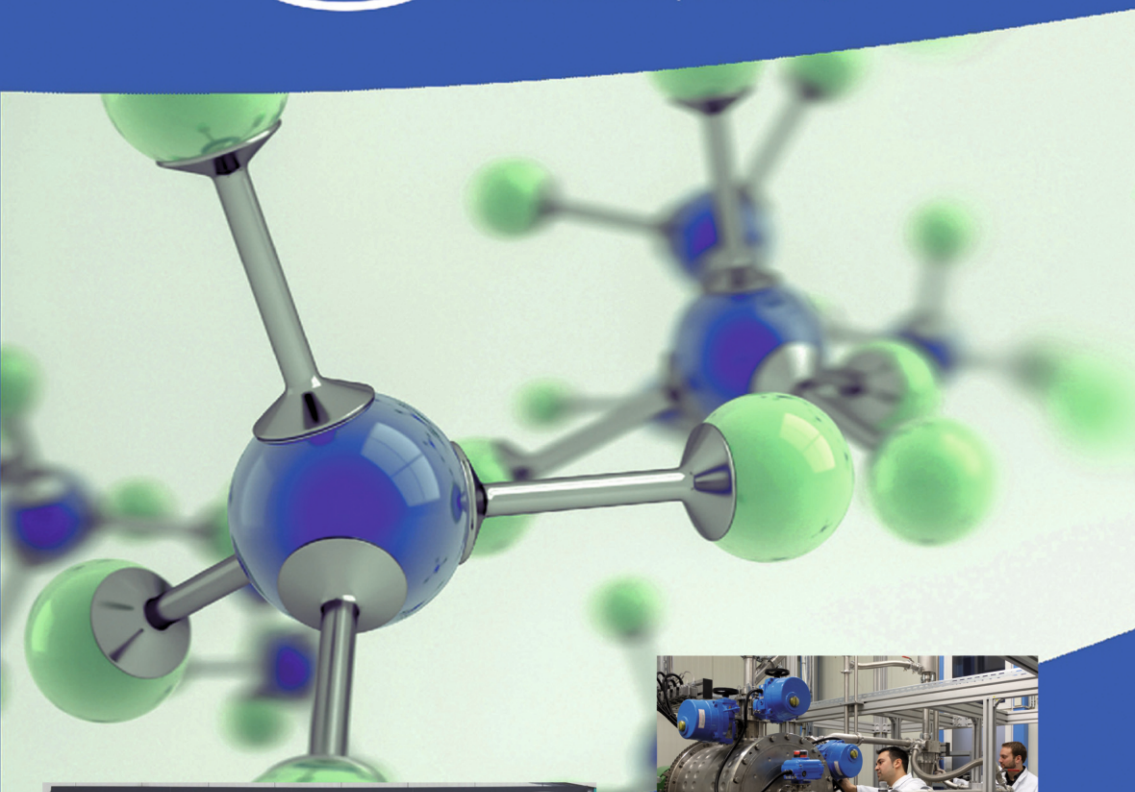




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V12 **Hanyang University - ERICA Campus**
**Department of Metallurgy and Materials Science**
Ansan, Seoul, Korea

**Prof. Dr. Jai-Sung Lee**
Full member, National Academy of Engineering of Korea, Past President of KPMI

### Progress in Bimodal Nanopowder Processing

Powder Metallurgy (PM) processing of nanoscale metal powders has been of great interest in that it can realize fabrication of high performance PM parts with saving process-energy and using cost effective materials. The present presentation introduces our researches on finding a breakthrough how to process a high strength iron PM parts using Fe nanopowder. The most important issue is a question; "Is it possible to achieve a high strength pure iron PM parts only by grain refinement effect without alloying treatment?" To solve this problem, our researches have been focused on understanding the consolidation of bimodal nanopowders with various size ratios (three Fe bimodal powder systems of large micro-nano, fine micro-nano, nan-nano powder mixtures). It was experimentally found that the bimodal nanopowders in three powder systems underwent a full densification and slow grain growth during compaction and sintering. As a result, mechanical properties were remarkably improved. The key idea of these studies is based upon the optimization of structure design and full density process of micro-nano or nano-nano type bimodal powder mixtures into fine-grained Fe PM parts. Especially understanding the roles of hierarchical interfaces in nanopowder agglomerates on densification and grain growth during sintering is stressed.

V13 **AIDIMME Instituto Tecnologico**
Paterna (Valencia), Spain

**Luis Portolés Griñan**
Senior Research Coordinator

### Pure Copper processed by Electron Beam Melting (EBM) technology for industrial applications

The technology Electron Beam Melting (EBM) enables to melt metal powders for building parts with near full density from a 3d file. The powder is processed in a vacuum chamber reaching values of temperature close to 50% of the melting point of the metal alloy. Most common materials ready for the market are Ti6Al4V, Ti6Al4V-ELI, Titanium Grade-2 and Cobalt Chromium ASTM-F75. A wider range of materials suitable to be processed shall allow expanding the industrial applications of this technology.
AIDIMME has researched on the development of the parameters setup for processing pure-Copper by means of EBM. This research was done along the last 3 years for a specific and patented industrial application: Induction heating. This is the process of heating an electrically conducting metal by electromagnetic induction. Induction heating allows the targeted heating of an applicable item for applications including surface hardening, melting, brazing and soldering and heating to fit.

V14 **Russian Academy of Science Siberian Branch**
Tomsk, Russian Federation

**Dr. Alexander Ponomarev**
Senior Researcher, Surface Technology

### Mechanisms and conditions of chemical activity of the multiwall carbon nanotubes surface

A theory of the quantum kinetics of a many-electron system has been developed in the course of dissociation and the formation of new structures. Relaxation of excited electrons of gas atoms by means of the motion equation method is considered and conditions determining the dissociation of gas molecules and the formation of new chemical compounds are determined. The influence of oxygen on the properties of the surface of multiwalled carbon nanotubes (MWNTs) has been established and the regularities of the effect of the electronic structure of adsorbate on the chemical activity of the surface have been established. The conditions for the dissociation of oxygen and other gases on the MWNT surface are determined on the basis of experimental and calculated data.

# Session 07 | 12:00 - 12:45

## W06 [Welcome from Japan & Sri Lanka, Welcome to EUREKA]

**Ritsumeikan University**
Shiga, Japan & Colombo, Sri Lanka

**Prof. Dr. Monte Cassim**
Advisor to the President

**Ulm-Uni & EUREKA Metallurgy Europe**
Ulm, Germany

**Prof. Dr. Hans Fecht**
Director

***OZ-symposia during breaks - from Currywurst to German homemade Torte***

## V15

**Airbus Operations GmbH**
Hamburg, Germany

**Dr. Jens Telgkamp**
Head of Additive Manufacturing R&T

### Additive Manufacturing parts design - present and future in Airbus

Airbus R&T on Additive Manufacturing is investigating metallic and plastic AM technologies as well as design and stress principles for systematic optimization of components and bionic design. Without these technologies we would not be able to exploit the full potential of additive technologies.
The main focus is on flying serial parts rather than development prototypes and on full process qualification rather than single part qualification.
An overview over innovative development processes is given as well as on application examples and lessons learnt so far.

## V16

**HeatLab Ltd.**
**Ulyanovsk Center of Technology**
Ulyanovsk, Russian Federation

**Dipl.-Ing. Ilia Gvozdkov**
Leading Engineer

### Metal hydrides for energy mega and micro systems

Increasing energy demand, challenge for improving energy efficiency and development of technics cause the need for new efficient and eco-friendly power sources and energy storage systems. Fuel cells (FC) technology is one of promising path for the energetics in the future, while metal hydride systems are promising as a safety hydrogen source and storage. HeatLab Ldt is specialized in powder metallurgy and R&D in the field of metal matrix composites. The production is handled by industrial partner MetalComposite Ldt. HeatLab has achieved the efficient technology of magnesium hydride synthesis and is close to develop the low pressure chemical hydrogen source for mobile FC power systems. After the launch of a windmill farm end of 2017 near Ulyanovsk, HeatLab is going to enter the field of energy mega storage with development of solid state hydrogen storage systems. The presentation also demonstrates the developed composites with very high anisotropy and thermal conductivity and their potential for application in thermal management for metal hydride energy storage systems. HeatLab is open for cooperation and partnership to develop hydrogen storage and thermal management systems for European and Russian markets.

V17 **Höganäs AB**
Höganäs, Sweden

**M. Sc. Daniel Edman**
Market Development Manager,
Additive Manufacturing

### Customizing powders for Additive Manufacturing

The fast development and variety of technologies within Additive manufacturing create both possibilities and challenges in powder supply. Binder jet, Ink jet and filament technologies generally require fine powders similar to grades for Metal injection molding. Laser deposition technologies share in many aspects the same challenges as surface coating by overlay welding. High velocity deposition technologies requires soft or soft annealed powders, while the more established AM-technologies, SLM and EBM is favored by spherical shaped powders without satellites and entrapped gas pores. However, the future supply of powders for Additive manufacturing is not only about suitable powder properties but also about tailoring alloy design based on the possibilities and limitations from the various AM-technologies. While so far main focus in AM has been to match properties of wrought steel alloys, many research groups has initiated the work to design materials based on the prerequisites of AM. Höganäs has recently acquired a new atomization technology, allowing not only spherical powders free from satellites, but also unique alloys, phases and microstructures. With this new technology Höganäs aims to support the visions of the researchers by bringing them into commercial reality.

V18 **Westphalian Energy Institute**
Gelsenkirchen, Germany

**Dr. Ulrich Rost**
Project coordinator hydrogen
energy systems

### Durable PEM Fuel Cells with Ultra-Low Noble Metal Loading

Fuel cells are electrochemical energy generators using hydrogen and oxygen to provide electrical energy. Since the reaction product is water, the fuel cell process is environmental friendly and a potential solution for CO2-free energy generation in the near future. Electrochemical reactions in polymer electrolyte membrane fuel cells (PEMFC) occur on the surface of noble metal catalysts. Increasing the reaction rate, to provide higher specific power output, may be facilitated by using catalyst material with higher catalytical activity as well as by increasing the electrochemical active surface area (ECSA). In the frame of the ongoing R&D project “LOCOPEM” a PEMFC electrode is being developed with an ultra-low platinum loading of about 10µg/cm². In laboratory tests, high power density has been achieved due to an advanced catalytic layer, that provides superior ECSA in contrast to typical electrode structures. The developed electrode structure contains platinum nano particles supported on carbon nano fibres (CNF). In accelerated stress tests higher corrosion stability in comparison to commercially available catalysts is determined. Results of this study are presented in this work. Further optimisation may be achieved by the use of platinum-cobalt-alloys as catalyst material.

V19 **Institute of High Pressure Physics**
**Polish Academy of Sciences**
Warsaw, Poland

**Prof. Dr. Witold Łojkowski**
Head of Laboratory of
Nanostructures

### Green nanotechnology for nanoparticles synthesis, nanocoatings and nanocomposites

We exploit microwave, ultrasonic and high pressure technologies for synthesis and processing of nanoparticles (NP) at temperatures from 20°C to 260°C. Precise control of NP size is crucial for their application. Since high driving forces exist to coarsen the particles relatively low temperature of synthesis and processing conditions are needed.
At Microwave Solvothermal Synthesis (MSS), liquid reagents enclosed in a tight container are heated using microwave energy at uniform heating up to 1 K/sec and process time controll precision of 1 sec. We produce highly crystalline NP with narrow size distribution and mean particle size precisely regulated. Examples are of ZnO (20 to 120 nm) and Hydroxyapatite (6 to 56 nm).
At Sonocoating, ultrasonic energy is used to create thin films from NP. A sonotrode and the substrate are immersed in a colloidal suspension of NP, solvent can be water. At a critical size the bubbles collapse and their implosion creates a high pressure gradient, which throws the NP towards surfaces. Coating made from nano-HAP was shown to be efficient for bone re-growth scaffolds. Highly efficient antibacterial coatings have been created. High pressure compaction permits to obtain dense NP at relatively low temperatures.

V20

**Southern Taiwan University of Science & Technology STUST**
Tainan City, Taiwan

**Prof. Dr. Cheng-Hsin Chuang**
Director, Roll2Roll Imprinting Flexible OptoElectronics

### Nanomaterials for Effective Biochemical and Physical Sensing Technologies

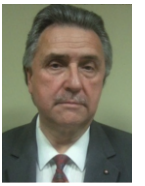
Nanotechnology based sensors are providing new solutions in biological, chemical and physical sensing which enable enhanced sensitivity and specificity, multiplexing capability and portability for applications ranging from healthcare to safety and environmental monitoring. In our lab, we conduct interdisciplinary research encompassing areas such as materials science, biotechnology, biochemistry and electrical engineering to develop novel sensing technologies using nanomaterials. For example, we have developed electrochemical immunosensors utilizing nanoprobes (nanoparticles conjugated to antibodies) which enable improved sensitivity for the detection of bladder cancer and chronic kidney disease. This involves synthesis of nanoparticles (colloidal gold, alumina or core-shell structures such as polystyrene/silver) followed by surface modification with bifunctional ligands like cysteamine or thiol-PEG-amine to enable effective covalent conjugation to antibodies. These nanoparticles not only enable enhanced bioreceptor immobilization, but also improve charge transfer and even act as transducing elements themselves, thus resulting in low achievable limits of detection such as our multiplexed electrochemical immunosensor which can detect Gal-1 (biomarker for bladder cancer) in pg/ml range.

*(shortened - pls. see proceedings)*

V21

**Institute of Technical Sciences of SASA**
**Serbian Academy of Sciences and Arts**
**Faculty of Electronic Engineering - University of Niš**
Belgrade, Serbia

**Prof. Dr. Vojislav V. Mitić**
Scientific Advisor



### Microcrystalline Diamond Films Fractality Exploring

Diamond is renowned as a material with superlative physical qualities, most of which originate from the strong covalent bonding between its atoms. Diamond has the highest hardness and highest thermal conductivity of any bulk material and those properties determine the major industrial applications in cutting and polishing tools, windows, heat spreaders, and the scientific applications in diamond knives, anvil cells, and as an optical detector material. Although is thermodynamically less stable than graphite, the conversion rate from diamond to graphite is negligible at standard conditions. The method for synthesizing diamond using a low-pressure was chemical vapor deposition (CVD) technique. Typical CVD diamonds consist of numerous small crystallites forming a continuous film. Taking into account the basic principles of growth and thin film formation, the possibility of application fractal geometry and analysis might be reasonable. Fractal theory may help to find order where it seems that only chaos exists. The process of CVD, by its definition is created to introduce higher degree of order, starting from a totally chaotic entity. Thus, it is a challenge to recognize, measure and explain the fractal nature of thin diamond films. This paper is a step towards this direction.

V22

**Tomsk State University**
Tomsk, Russian Federation

**Dr. Nadejda Bobenko**
Researcher at ISPMS SB RAS

### Electronic properties of disordered 2D graphene

A theoretical study of density of states (DOS), resistivity, heat capacity and thermal conductivity of metallized 2D graphene with impurities and structural inhomogenities is performed at low temperatures under the assumption that graphene contains the short-range order types structures. The conditions for the appearance and disappearance of a gap in the DOS are obtained for the case of the defects location changes. The contribution to the resistivity is shown to increase when temperature rises if the foreign atoms move from the second coordination sphere to the first one and decrease in the opposite case. Temperature dependence of relaxation time, DOS, resistivity, heat capacity and thermal conductivity is sensitive to the concentration of defects and the types of short-range order (structural inhomogenities) and may be described only in the presence of the structures forming large-area 'cells' in the graphene layer.

V23 **HoDforming GmbH**
Duesseldorf, Germany

**Prof. Dr. Jürgen Hirsch**
Chief Technology Officer (CTO)

### Hot Die Forming Aluminium - ultimate lightweight under highest forming freedom at substantial materials savings.

Hot Die Forming (HDF) of Aluminium represents a revolutionary new technology for precise high-temperature forming of metal flat products (HDF-F$^{Al}$) and hollow products (HDF-H$^{Al}$), where in addition to the heated metal flat and hollow blanks, also the forming tools are advantageously permanently tempered.
For ultimate light-weight applications, several high-strength aluminium alloys are already on the market (6xxx & 7xxx, Zentallium$^{®}$) however, there is a lack of adequate manufacturing processes for producing complex parts. Only both aspects combined - lightweight high-strength materials and an appropriate forming technology - enables to manufacture the desired products high-volume parts in an efficient way.
The present paper explains the HDF process and manufacturing in high volume production stage with examples particularly in the automotive industry where the processing of high strength aluminium under high pressure is expected to decrease the overall weight of the car in short and medium term dramatically. Insofar, the major application field is seen mainly in the high-volume segments (B and C) but also in the luxury upper-segments.

*(shortened - pls. see proceedings)*

V24 **Helmut-Schmidt-University - HSU**
**University of the Federal Armed Forces at Hamburg**
**Helmholtz-Zentrum Geesthacht - HZG**
Geesthacht & Hamburg, Germany

**Prof. Dr. Thomas Klassen**
Head of the Institute of Material Science at HSU, Director of Materials Technology Div. at HZG

### Cold Spraying for Additive Manufacturing and Repair

Within the last two decades, cold spraying has developed from a laboratory deposition technique to a reliable process for applications that demand a high coating purity and the preservation of unique feedstock properties. For metals, the process is well understood, and forecasting deposit performance can already be performed by commercially available software. Exceeding a material specific critical velocity, successful bonding occurs by the formation of adiabatic shear instabilities (ASI), which, lead to local thermal softening at particle interfaces, over-compensating strain and strain rate hardening. As compared to selective melting and related techniques, cold spraying provides an order of magnitude higher deposition rates. Thus, the method is well suited as additive manufacturing tool. With respect to needed strengths in later applications, spray conditions aim to optimum bonding between particles in the as deposited layer. The present contribution summarizes strategies to gain the needed deposit properties and gives examples for applications of cold spraying in repair or additive manufacturing of parts.

V25 **Zoz Group**
Wenden, Germany

**Prof. Dr. Henning Zoz**
CEO & President

### Making more with less & Concluding Remarks

Modern mankind is solving all its challenges with energy. The bottleneck in that is represented by the availability of a limited resource by nature: materials. This leads to the understanding, that there is no waste on this planet but material, leads to ultimate recycling and to the requirement of increasing the materials performance - making more with less. Thus functional units are becomming smaller and smaller, thus materials structures following the same path. That explains why nanotechnology likewise nanostructured materials either are or will be applied practically everywhere. Insofar it is not surprising, that also at Zoz, "the Nanostructure Company" since 25 years, the range of processing equipment and materials manufacturing/processing development covers quite a wide range in both, application/utilization and market goal. Presentation covers a brief survey on present equipment, products and projects and future plans from High Kinetic Processing to High Performance Concrete to Hydrogen & Energy to ODS and also touches Additive Manufacturing giving an important renaissance to powder technology.

# Technical Excursion

## Technical Excursion No.2 heading to ZCS

All posters will be on display during the entire Symposium right in the exhibition area

# Poster Sessions

10th International Symposium on
10th German-Japanese Symposium on

P01

**IME - Fraunhofer-Institute for Molecular Biology & Applied Ecology**
**WWU - Westphalian Wilhelms-University**
Muenster, Germany

**Prof. Dr. Dirk Prüfer**
Head of Plant Biopolymers &
Vice Dean

### Improved plant biomass for efficient biopolymer production

Plants form a central component of our modern bioeconomy by providing food, feed, energy and raw materials such as biopolymers for industry. The sustainable supply of these materials depends on our ability to produce sufficient amounts of biomass, but this is threatened by the increasing global population and the corresponding erosion of arable land and freshwater resources. One of the grand challenges in agriculture is therefore to double the biomass yield per hectare and hence increase the productivity of agriculture to meet the growing demand. One way to achieve this is to genetically reprogram the lifecycle of key plant species to increase growth and delay senescence and death. This will enhance biomass production and improve the yields of food, feed, energy and industrial raw materials. We have identified key regulatory genes in plants that control flowering and allow plants to live longer and produce larger amounts of biomass. Using this information, we have increased biomass production in tobacco by 500%. Beside food production, this is also a major breakthrough for chemical industry because it will guarantee the environmentally-beneficial and sustainable provision of plant-derived chemicals and raw materials long into the future.

P02

**Karlsruhe Institute of Technology - KIT**
**Institute for Applied Materials**
Karlsruhe, Germany

**Dr. Jan Hoffmann**
Materials Scientist

### Improving the production process of Austenitic ODS Steels

In 2050 the electricity consumption will more than double that in the year 2005. Therefore, it is necessary to both increase the efficiency of existing power plants, like solar tower power plants, and to develop advanced power sources, like fusion power plants.
One of the major areas of interest is increasing the operating temperature of modern and next generation power plants. For that reason, structural materials, which can sustain hazardous conditions and high temperatures, are needed. Austenitic ODS steels are a possible candidate for future power generation plants, when they overcome typical drawbacks, like a low production yield and introduced impurities during the mechanical alloying process.
The present research is showing possible solutions to increase the production yield and determine the adequate mechanical alloying time for austenitic ODS steel applying XRD and SEM methods. KIT is also performing research towards a direct extrusion process of austenitic ODS steel powder to produce tubes for power plants and has already achieved first success.

P03

**Rhine-Waal University**
**Faculty of Technology and Bionic**
Kleve, Germany

**M.Sc. Mathias Pacaud**
PhD Student

### Multifunctional nanosystems for the theranostic treatments of the mammal cancer

Nowadays, the classic detection of the tumor cells is initially based on the mammography which can detect only 12% of the positive mammographies at late stage. Thus, the development of very sensitive and specific methods for early stage detection is critical for recovery and recurrence. The proposed research aims to develop hybrid multifunctional injectable nanosystems targeting cancer cells of the breast cancer. These "theranostic nanosystems" allows the early diagnosis and the treatment of the tumor cells simultaneously. The hybrid nanosystems based on organic-inorganic nanostructures exhibit unique magneto and plasmonic properties. These nanosystems will not only be able to deliver chemotherapy agents but also allow the destruction of the cancer cells by magnetic hyperthermia and the identification of the tumor cells during the surgery by using the optical endoscopy in the close infrared (700-900 nm) region.

*(shortened - pls. see proceedings)*

P04

**Rhine-Waal University**
**Faculty of Technology and Bionic**
Kleve, Germany

**M.Sc. Viraj Pratap Nirwan**
PhD Student

### Electrospinning towards functional hybrid materials

Hybrid fibers present platform to unite two modalities (polymers and inorganic moieties) widely found in nature, rarely engineered at small length scales due to restrictions like wide array of physical, chemical properties and processing environments. Electrospinning overcomes these restrictions by combining many dissimilar modalities via incorporating functionalities of those dissimilar building blocks into hybrid fibers at nanoscale. Efficiently fabricating electrospun nanofibers with high surface area to volume ratio facilitating multifunctional alternative for wide biomedical applications as well as filtration, tissue engineering among others. One such process being used herein employs Poly (ethylene oxide), chitosan as matrix with dendrimers, SPIONs, gold nanoparticles as functional elements to generate electrospun hybrid nanofibers averaging 130 nm. With potential such as magnetic field induced hyperthermia and dendrimer's attachment and drug loading modalities. The fibers were then characterized to distinguish them from unadulterated fibers. Various techniques used includes TGA, DSC, FTIR and microscopy.

*(shortened - pls. see proceedings)*

P05

**Kunming University of Science & Technology**
Kunming, Yunnan, P. R. China

**Prof. Dr. Xiaolan Cai**
Faculty of Metallurgical and Energy Engineering

### High Energy Ballmilling and Technology of Metal Matrix Composites Powder

High Energy Ballmilling (HEM) is used for the Mechanical Alloying (MA) of superfine and nano-powders, Ductile Metal-Flakes (DMF), complex alloys by solid state and other. Prof. Cai's team researched the Superfine and nano-powder of metal Flakes and Alloy, Metal matrix Composites Powder, positive and cathode battery powder use the High Energy Ball-milling technique. The present presentation concludes encouraging results of the past 2 years.

P06

**Brno University of Technology**
**Central European Institute of Technology - CEITEC**
Brno, Czech Republic

**Dr. Ladislav Čelko**
Deputy Head of Research Group - Senior Researcher

### Spark Plasma Sintering - Introduction of Thermal Barrier Concept to the New Reproducible Way of Extrusion

Spark plasma sintering (SPS) is currently a major powder consolidation process with many advantages, however it is still limited to the processing of simple shapes such as discs due to its geometric restrictions. SPS products have previously been further processed using secondary processes like hot extrusion or rolling, which have resulted in further enhancements in the sintered material properties. Alternatively, single-step spark plasma extrusion (SPE) is a recently developed process that has superiority over SPS in terms of faster consolidation, generating products of extended geometries and potential grain refinement capabilities under applied current. So far, work on SPE has been conducted in tool steel extrusion containers initially maintained at room temperature. This can lead to rapid loss in billet temperature during extrusion, and a microstructure that varies considerably along the extruded length. The present paper reports two novel contributions. First, SPE has been conducted for the first time in a heated graphite die using conventional SPS equipment. Second, a thermal barrier approach is proposed that allows for more uniform temperature distributions during SPE. Results show that aluminium and aluminium-carbon nanotube composites have been successfully processed using the new approach.

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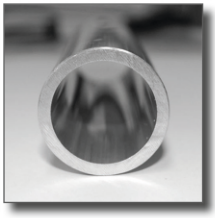

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### MechanoChemistry
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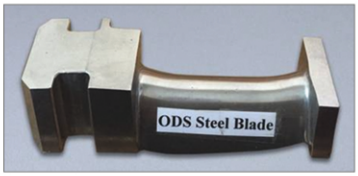
**for making nanostructure** | **grain-size control by nanostructure** | **nanostructured solid state absorber** | **creating new nanostructures**




## ODS/NFA
Oxide Dispersion Strengthened >> Nanostructured Ferritic Alloys manufactured by high kinetic processing (HKP)

**PM2000 | PM2017 | PM2018**

The Nanotun3D project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 685952.

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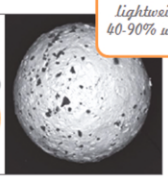

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P07

**Brno University of Technology**
**Central European Institute of Technology - CEITEC**
Brno, Czech Republic

**Ing. David Jech**
PhD student

### Durability & phase stability of YSZ coating with high porosity content & multilayer Mullite-YSZ/YSZ coating after HT exposure

This work is focused on evaluation of quality of hard $Al_2O_3$+13% wt. $TiO_2$ and $Cr_2O_3$ coatings produced by means of atmospheric plasma spraying technique. The different technological process parameters, namely the plasma torch stand-off distance, gas flow rate, current, particle temperature and velocity were varied during deposition. In-flight particles temperature and velocity were monitored during spraying using Tecnar AccuraSpray G3C (on-line particle monitoring system) unit. The main aim of the contribution is to optimize a quality of resulting microstructure, with respect to the coatings thickness, amount of unmelted particles, microcracks and porosity at inter-splat regions, which were studied in detail. Based on the results obtained from AccuraSpray system and scanning electron microscope equipped with energy dispersive microanalyzer, the technological parameters providing optimal microstructure of both studied $Al_2O_3$+13% wt. $TiO_2$ and $Cr_2O_3$ coatings were identified.

P08

**Zoz GmbH**
**Zoz Technology Center**
Wenden, Olpe, Germany

**Dr. Birgit Funk**
Scientific Director

### MechanoChemistry - solvent-free Chemical Reactions by Simoloyer® Technology

Mechanochemical processing is the term applied to powder processing in which chemical reactions and phase transformations take place during high energy milling due to the application of kinetic energy. An important feature of the process is that plastic deformation and chemical processes occur almost simultaneously. A unique example of such mechanochemical reactions are stoichiometric reactions between materials that form a local surface plasma by sudden breakage of numerous metal-oxygen bonds are also called as tribochemical reactions which were successfully carried out in the high energy mill Simoloyer® CM01-2lm designed and manufactured by Zoz GmbH. The novel materials synthesized in this way have already found application areas such as hydrogen storage materials, gas absorbers, food, pharmaceuticals and also in fine chemical synthesis. This technology has become a large effort in the general field of reactive milling.

P09

**Nuclear Research Centre Negev - NRCN**
**Israel Atomic Energy Commission**
Be'er Sheva, Israel

**Dr. Ori Yeheskel**
Senior Research Scientist

### Mapping the tray of Electron Beam Melting (EBM) Ti-6Al-4V samples - Properties and Microstructure

We present a study on the dependency of physical properties (density, elongation, tensile strength and fatigue limit) and microstructure on the geometrical location in a tray of powder bed EBM. It was found that the mechanical properties slightly depend on the order of melting. It seems that when applying high percentage (above 50%) of melted surface, there are density variations and the mechanical properties deteriorate near the edges of the tray. Nevertheless, upon applying HIP (Hot Isostatic Pressure) post process, samples can reach higher density accompanied by very high elongation (>18%) with uniform strength and fatigue limits of 570 MPa.

P10 **University of Ulm**
**Institute of Micro and Nanomaterials**
**EUREKA Metallurgy Europe Cluster**
Ulm, Germany

**Prof. Dr. Hans-Jörg Fecht**
Director

### Metallurgy Europe: progress of the EUREKA cluster in the field of materials development and manufacturing

While it is true that innovation often comes in the form of well-designed components and clever combinations of pre-existing elements, the discovery of novel materials can open up new realms of possibility, and give rise to a flood of potential products and applications. Historically, materials science has often contributed the optimized substances necessary to fabricate fast cars, tall buildings and strong components - but in recent decades, it has taken on a second, more subtle role as the originator of advances in fields including electronics and chemistry and application driven.
Materials science has always been a topic of crucial significance to industry, and therefore also to EUREKA. EUREKA has evolved accordingly, implementing initiatives such as the Metallurgy Europe cluster with the support of 280 industrial partners and top research institutions. Metallurgy Europe has been launched in 2014. It is concerned with the discovery and design of high-value metal products, and is set to run into 2020.
Since the cluster is still in its initial phase with a budget of ca. 85 mio. € one of the key projects has been implemented in the field of "additive manufacturing". According to the current call more projects are expected in particular in the field of powder metallurgy.

P11 **Night Queen Airlines NQA**
Almere-Haven, The Netherlands

**Rajesh Debie**
CEO

### Building Sanjiwany Supersonic Aircraft Mach 3/7 with PM2000/PM2017 skin

The Sanjiwany project at NQA started in January 2017 with the goal of designing and manufacturing supersonic aircrafts what will fly at Mach 4 and Mach 7. Further future goals are the Sanjiwany satellite launcher that can fly at Mach 9 Speed and can launch 8 satellites at the same time. Project volume is exceeding 2 Billion Euro. From materials science / nanostructure point of view, the outer skin of the vessel represents a major critical section. Supersonic Mach 4 result in outside AC body temp. of 800°C, M9 already at 4.000 °C. For the M4 flight, an advanced ODS-material at honeycomb structure at permanent cooling based on the former Plansee material is developed and e. g. could be provided by ZOZ/Germany (PM2017). This project will be overall demonstrated, safety issues according EASA rules for this first SSAC in Europe after the Concorde will be given. That includes its frame work, wings landing gear, ram aero engines, scramjet and fusion technology and ion engines to be implemented as well as hydraulic, pneumatic electric systems according ATA 100 breakdown. The first take of from the demonstrator is planned for 2019 at Lelystad airport. This will be the Mach4 aircraft.

P12 **CIITEC-IPN**
**T & I Research Center - National Polytechnic Institute**
Santa Maria, México

**Prof. Dr. Sebastián Díaz de la Torre**
Director of CIITEC

### Construction of the largest "Virgin of Guadalupe" statue in the world using High Performance Concrete.

With the purpose of developing a religious tourism center in the city of Guadalupe, located in the State of Zacatecas, Mexico, private investors in collaboration with the local government of Guadalupe Zacatecas have reached an agreement to encourage religious tourism, while creating job opportunities. This religious tourism center will include a high performance concrete HPC-made statue of the Virgin of Guadalupe 47 meters high, which will be larger than the Christ of the Corcovado, in Rio de Janeiro, of 39.5 meters, and that of the Statue of Liberty, in New York, of 37 meters.
More than 80% of Mexico population is Catholic and its economy partially but importantly relies on recreational and religious tourism. Thus, every year millions of people come to worship the churches that house the "Virgin of Guadalupe", thus this project in the City of Guadalupe is expected to substantially increase its economy. Taking advantage of new technologies and advanced materials, such as HPC, which can be processed by high kinetic ball milling technique, a robust and fast construction like the one presented here can be realized in near future. Laboratory research carried out in CIITEC-IPN for more than 15 years, in collaboration with Zoz-Group has demonstrated feasibility and convenience of constructing a number of innovative products. The core of the statue/building will be constituted of a steel framework (include elevator) and composed Portland cement CPC, whereas the skin of statue will be made using superfine HPC.

P13 **Osnabrueck University of Applied Sciences**
**Institute of Materials Design and Structural Integrity**
Osnabrueck, Germany

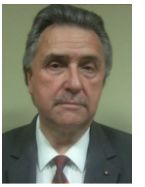
**Prof. Dr. Ulrich Krupp**
Head of Institute

### The potential of mechanical alloying to produce ultra-fine grained alloys for applications at elevated temperatures

Most engineering alloys show a substantial deterioration of the mechanical properties when they are applied at elevated temperatures, e. g. in process engineering, power generation or mobility. This is attributed to creep and the gradual disappearance of the hardening effects by grain refining and the small precipitates due to coarsening processes. High-energy ball milling of aluminum alloys and high-entropy alloys in combination with non-metallic zinc ferrite spinel (ZnFe2O4) leads to mechanical alloying and a transformation to ultrafine-grained 0.1 to 0.5mm size flakes. After hot isostatic pressing (HIP) the materials are extruded and machined to cylindrical tensile, fatigue and creep specimens. It was shown that the ultrafine-grained materials exhibit superior mechanical properties under monotonic and cyclic loading conditions. The ultrafine grained structure (grain size about 200-250nm) is maintained at elevated temperature due to the presence of small ceramic particles that effectively pin the alloy grain boundaries.
It is envisioned to adapt the alloying concepts also to additive manufacturing. The Institute of Materials Design and Structural Integrity has recently been started to run a new facility on metal powder production and selective laser melting, which is introduced briefly in this poster presentation.

P14 **Institute of Technical Sciences of SASA**
**Serbian Academy of Sciences and Arts**
Belgrade, Serbia

**Prof. Dr. Vojislav V. Mitić**
Director



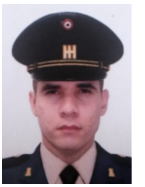
### The Impact of Crushed Mineral Aggregate Water Absorption Value on the Required Properties of Road Pavement Concrete

When discussing about crushed mineral aggregate for designing concrete mixes for construction of concrete road pavements, the national standards require prescribed resistance to crushing and wear according to “Los Angeles” method and frost resistance. The road pavement concrete must have a proscribed value of resistance to penetration of water under pressure, watertightness of concrete, resistance to frost min M-200 (200 - denotes the number of freezing-thawing cycles,) wear resistance by Bohme: 18 cm3/50 cm2 in dry state, 35cm3/50cm2 in water saturated state and maximum water cement ratio of 0,5. Experimental results suggest that coarse aggregate may have higher water absorption percentage than the permitted one and still be used for making of road pavement concrete. Experiments indicate that the main role in the concrete frost resistance is played by the structure of created cement rock in concrete. Using the appropriate admixtures, such as hyperplasticizers, considerably reduces water/cement ratio, and thus the percentage of voids and pores in the created cement rock and using the air entraining agents, achieves the required percentage of entrained air which makes the concrete resistant to frost action.

*(shortened - pls. see proceedings)*

P15 **Escuela Militar de Ingenieros - EMI**
Mexico D. F., Mexico

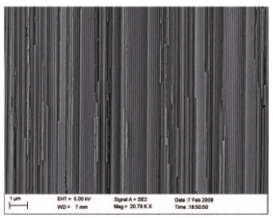
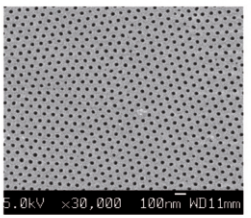
**Capt. Orlando Gutiérrez Obeso**
Head of Research Military Engineering School



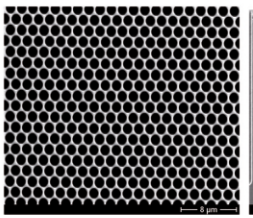
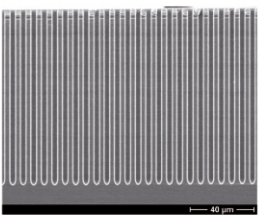
### A Meteorite's Amorphization and Characterization Study using Hig Energy Milling Technique

A Meteorite recovered from the Northern State Chihuahua Mexico was submitted to different techniques High Energy Milling, Particle Size Distribution, Xray-Diffraction, Heat Flux and High Resolution Microscopy.
Adjusting parameters, it was possible to generate nanoscale material (~28nm) and its amorphization through Mechanical Milling Technique (Simoloyer). Results of this research will be demonstrated and suggested to be applied in the development of ultrahigh performance cements (UHPC).

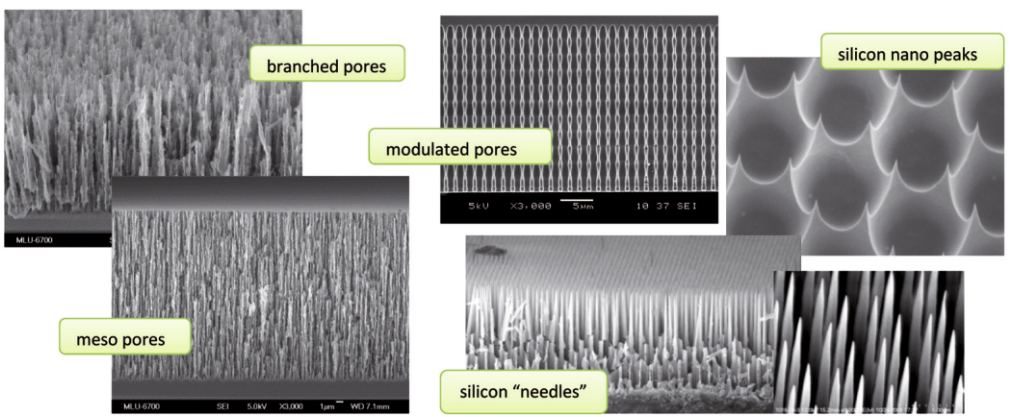
**SmartMembranes** is a producer of high quality macro and nano porous alumina and silicon membranes with high ordered structures and a narrow pore size distribution

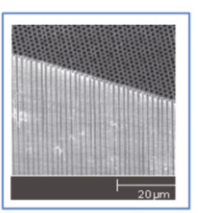

**nano porous alumina**
Ø Pore: 25-400 nm

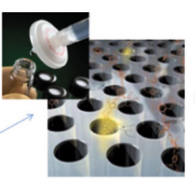



**macro porous silicon**
Ø Pore: 0.8-15 µm




- precise pore diameter (deviation < 10%)
- high aspect ratio
- strongly parallel pore growth
- application in filtration, separation, platform for sensors, biochips, fuel cell electrodes, drug delivery systems, micro chips and as templates for nanorods and nanotubes



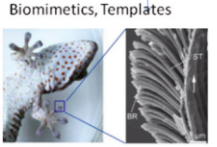



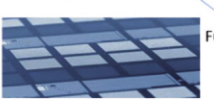
Filtration/Separation

Gas sensors

Biosensors
(® Axela Inc.)

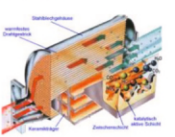
Biomimetics, Templates





Micro Systems Technology

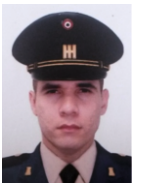
Fuel cells



SmartMembranes GmbH | www.smartmembranes.de | sales@smartmembranes.de | Phone: +49 345 4780 -250/-251

P16 **Escuela Militar de Ingenieros - EMI**
Mexico D. F., Mexico

**Capt. Orlando Gutiérrez Obeso**
Head of Research Military Engineering School



### Ultra High Performance Concrete applied to Mathematical Modeling for Structural Elements

The study of the mechanical properties is the main topic for civilian engineers to creating mathematical models to predict the behavior and design of civil engineering structures. Nowadays, all construction must comply standards to become safer places e. g. to live in.
This research demonstrates the promising path that Ultra High Performance Cement/Concrete (UHPC) could mean in the use of the construction. Comparison of earthquake resistance against normal concrete, resilience, armor constructions and military applications are some of the major goals at great relevance. It will be shown, that cement of high or ultra high performance can result in the development of a new generation of materials at world class level.

P17 **Shenzhen Sino-German Micro-& NanoManufacturing Innovation Center**
Shenzhen, China

**Dr. Xiang-Qian Zhou**
CEO

### Market-driven technology development platform for Micro-& Nano Manufacturing companies

Micro-& Nanotechnology belong to the core technologies within the German "Industrial 4.0" and European "Quantum Revolution". It is also an important high-tech field for China to implementthe"Made in China 2025" strategy. In the medium-and long-runit will help the country to catch up with international standards and to achieve the transfer from "Made in China" to "Innovation in China".
Micro-& Nanotechnology is nowadays used in many areas in our daily life. Examples: cell-phones, computers, automobile, medicine technology, materials science, energy usage improvements and environment protection.

P18 **HoDforming GmbH**
Duesseldorf, Germany

**Dr. Peter Amborn**
CEO

### HoDforming - a new hot die forming technology for high strength alloys

A new hot forming technology for high strength alloys (steel, Aluminium, Magnesium) is presented that enables the shaping of complex metal parts for applications like automotive, aviation or medical technology. The technology named HDF (Hot Die Forming) is focussed on high-temperature forming of metal flat products (HDF-F) and hollow products (HDF-H), whereby - in addition to the heated metal flat and hollow blanks - also the forming tools are advantageously permanent tempered. The technology is able to form crucial high-strength aluminium alloys (6xxx & 7xxx, Zentallium®) since the process is performed in the solid solution temperature range, allowing extreme forming ranges and additional subsequent quenching to a supersaturated solid solution level, that generates very fine nano-scale precipitates in extreme high concentration, providing optimal age hardening conditions. Thus this innovative technology combines extreme formability with extreme (age) hardening response of critical alloys. Both aspects combined - lightweight, high-strength materials and an appropriate forming technology - enable to manufacture precise parts, also suitable for high-volume production in a most efficient way, e. g. for the automotive industry.

P19 **Daegun Technology Co., Ltd.**
**Deaguntech - dpert**
Gyeongsangnam-do, Korea

**Sung Min Kang**
3D Team Leader

### Metal 3D printer development for excellent metal output

As a manufacturer for industrial cable and hardware equipment, DaegunTech started developing Chip-Mounter systems, Wire-Cut Electrical Discharge Machines and Screen Printer. Thus the way to a Metal 3D Printer was not too far and this poster will further describe motivation, solutions and realization of designing and manufacturing highly reliable Additive Manufacturing equipment. The brand is called "dpert", is based on in-house research and development resulting in a selective laser melting (SLM) family of devices. It will be shown, how metal powder is melted by laser to producing more precise output than DED method which spraying powder directly. "dpert metal 135" can achieve high quality metal output with excellent precision and stability, thus reducing user time and cost.

P20 **Zoz GmbH**
**Zoz Technology Center (at Olpe)**
Wenden, Germany

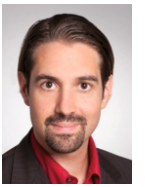
**Dipl.-Ing. Hans Ulrich Benz**
Member of Management

### High Kinetic Processing by Simoloyer® - efficiency and applications

New and improved products in fields of additive manufacturing, construction, chemistry and affiliated areas require novel materials and compounds which can be applied in currently present, enhanced or innovative technologies. Therefore powder technology can be a suitable method in development and improvement of high performance alloys, chemicals and pharmaceuticals, pigments and compounds or nano-structures.
Here the Simoloyer®-Technology shall be described as a versatile tool for High Kinetic Processing (HKP) which includes principles of Mechanical Alloying (MA), Reactive Milling (RM) and High Energy Milling (HEM) in lab and industrial applications. The advantages and efficiency of the high Maximum Relative Velocity (MRV) combined with the effect of collision of grinding-media and the energy transfer to the powder materials as well as the related Mechanical Process Engineering will be highlighted in some examples and applications.

P21 **Institute for Occupational Health and Safety (IFA)**
Sankt Augustin, Germany

**M.Sc. Christian Schumacher**
Head of unit Exposure Assessment



### Evaluation schemes for an improved control banding of nanomaterials

The knowledge on the hazard of nanomaterials towards protected persons or the environment is quite complex. Within the German nanoGRAVUR project different criteria catalogues for a grouping of nanomaterials according to the respective potentials for exposure, hazard and risk were developed. Among others, carbonous nanoparticles, $SiO_2$, $TiO_2$ and activated cement were studied. Additionally to existing knowledge material properties like the particle shape, the kind of material (powder, compound material, coating), the propensity for dispersion and the kind of processing were tested for the degree of release and exposure.
The aim is to improve risk assessment and to facilitate the choice of protective measures during use of nanomaterials for all kind of applications in companies, but also for end users and the protection of the environment.

P22

**Zoz GmbH**
**Zoz Technology Center (at Olpe)**
Wenden, Germany

**M.Sc. Somnath Vijay Divanjee**
Hydrogen, B4S & H2Tank2Go®

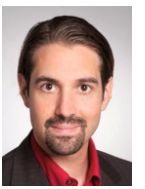
### H2-tank B4S - boron based nanostructured reactive complex metal hydride, semi-commercial incl. TÜV-approval

The EU-funded project BOR4STORE focused mainly on developing novel boron-based hydrogen storage materials with high capacities. In this frame, the multimodule tank system B4S-MM has been designed with fast, reliable and cost-effective high capacity solid state hydrogen storage materials from reactive hydrogen composites (RHC) based on boron hydrides. The storage capacity ($LiBH_4/MgH_2$) is 8wt. %, and 80 kg $H_2/m^3$. Loading time at 50 bar is less than 1 hour. The tanks are suitable for an operating temperature up to 650°C and pressure up to 350 bar. The construction of the hydrogen storage tank with integrated SOFC was designed according to international rules for pressurized containers and systems and obtained German TÜV certification according to AD2000 technical guidelines.

P23

**Institute for Occupational Health and Safety (IFA)**
Sankt Augustin, Germany

**M.Sc. Christian Schumacher**
Head of unit Exposure Assessment



### Nanorama - a virtual reality training for handling nanomaterial at the workplace

Information about possible hazards and exposure while handling nanomaterial is limited. Consequently, risk measurement measures (RMM) are applied. However, RMM can be implemented more efficiently if employees do understand why they should apply them. New forms of schooling may enforce the employees to respect suggested RMM. Nanorama - a lexical blend of "Nano" and "Panorama" - addresses employees ab initio by means of practical issues and examples regarding safe handling of nanomaterial at the workplace. They offer a 360° virtual environment with (a) integrated links and videos, (b) references and hyperlinks to additional information and schooling material and (c) a quiz with (multiple-choice) questions.
Due to the attractive visual implementation Nanorama inspire and encourage users to reflect nanomaterial related health and safety aspects in their own work environment. Embedded in a training program it is a valuable tool for workplace specific education of employees as well as health and safety managers.

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**Zoz GmbH**
**Zoz Technology Center (at Olpe)**
Wenden, Germany

**Tom Zoz**
Coordinator R&D

### Revitalization of Plansee's PM2000 ODS-alloy and further developing ODS/NFA

A major focus at Zoz-customers is concentrated on the development of ODS-Steels. Due to their high temperature stability and strength along with a high irradiation tolerance, ODS-steels represent promising candidates for nuclear fusion and 4th gen. fission reactors likewise for components in gasturbines/aero- and combustion engines exposed to HT and high corroding environment.
In order to push development and commercialization, a group from core partners KIT in Germany and UCSB, ORNL as well as LANL in the USA was formed. Zoz negotiated with Plansee in 2017, to revitalize their former PM2000 (ODS-19YAT, Plansee until 2006). The "fine-grain/HIP" version is made in rods D40xL250mm on shelf, HIP kindly provided by Quintus at Sweden. In the next step planning, a so branded PM2017 (20YAL) not as bulk but as a powder available for Additive Manufacturing and after success, the next goal namely PM2018 (14YWT) is representing a nanostructured ferritic alloy (NFA). The desired materials in their chemical composition are:

| | | |
|---|---|---|
| **Pm2000** | Fe-19Cr-5.5Al-0.5Ti-0.5Y2O3 | **19YAT** |
| **PM2017** | Fe-20Cr-5.5Al-0.5Y2O3 | **20YAl** |
| **PM2018** | Fe-14Cr-3W-0.4Ti-0.25Y2O3 | **14YWT** |

In this cooperative project, Zoz is responsible for coordination, powder processing, HIP-can's manufacturing and dissemination. The presentation reflects the promising status from the view of Zoz.

## CONCEPTLASER
a GE Additive company

Metal 3D Printer
for Powder Metallurgy

From Lab to Industry

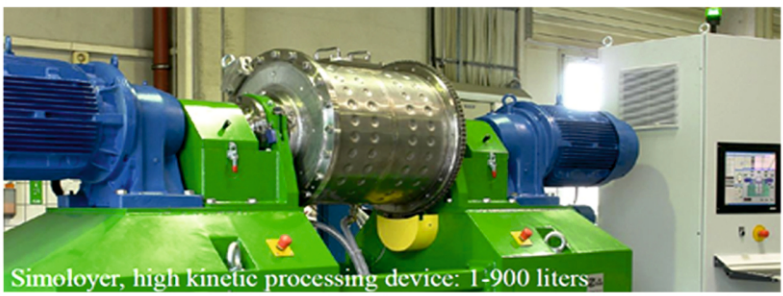

Mlab cusing


X line 2000R

## Zoz GmbH

Simoloyer

High Energy Milling
Mechanical Alloying
Reactive Milling
High Kinetic Processing
Mechano Chemistry



Simoloyer, high kinetic processing device: 1-900 liters

## BLUE POWER
Casting Systems

Mini Casting machine
Continuous Casting Machine
Tilting Casting Machine


MC20V


VTC800V

P25 **SmartMembranes GmbH**
Halle, Germany

**Dipl.-Chem. Monika Lelonek**
Managing Partner

### Thin nano porous alumina layers based on aluminum films deposited from ionic liquids

The focus of product development in the actual market in recent years is sensing and biomedical applications (gas sensors, biosensors, tissue engineering, controlled drug delivery and diagnostics). The products also serve as flow-through membranes for gas and liquid filtration as well as safety membranes against contamination (dust, bacteria, and viruses). Using defined surface modification, they can be applied as micro reactors or as catalysts. Classic biochip applications consist of a multiplicity of systematically ordered small spots. The biomolecular probes (antibodies, proteins or peptides) are linked to a planar 2D carrier made of glass, polymers or metals. Once in contact with a test substance, characteristic interactions take place in dependence of the molecules whereas the identity as well as the composition is detected as an optical or electrical signal. A future trend of those biochips are micro and nano 3D arrays, equipped with materials like the macro porous silicon and nano porous alumina where the pore structure is highly ordered and open. The pore diameters can be varied from 20 to 400 nm in alumina and from 800 nm to 10 µm in silicon.

*(shortened - pls. see proceedings)*

P26 **Zoz GmbH**
**Zoz Technology Center (at Olpe)**
Wenden, Germany

**Mr. Koray Kuzkaya**
R&D Division

### Zentallium® - status and challenges of a cost-effective lightweight material

High Kinetic Processing (HKP) by Simoloyer® is a superior and cost-effective technology not just for particle size reduction but also for the formation of nanostructures. HKP can be optimized from laboratory scale up to industrial scale. Mechanical alloying as a certain mode of HKP is a valuable technique for development of numerous novel and advanced materials. One of these is Zentallium®, which is one of the super-light-weight materials developed by Zoz GmbH. As an Al-CNT composite, it is lighter than aluminum and as strong as steel at half Titanium-alloy cost. The CNTs hinder grain size growth during consolidation and help to maintain fine crystallites in the microstructure. Fine grain hardening based on lattice defects (grain boundaries) is achieved. The result is an increase in strength paid with a loss in ductility. Zentallium® exceeds the strengths of stainless steels. The E-modulus is 20-30% higher than that of the aluminum base material. The CNTs stabilize this alloy system up to 240 °C, which exceeds commercial aluminum alloys. These properties make Zentallium® an outstanding lightweight material at low cost for particular applications. The presentation gives a survey on the material, its manufacturing and application.

P27 **Zoz GmbH**
**Zoz Technology Center (at Olpe)**
Wenden, Germany

**Alexander Zoz**
Assistant to the Board

### Nanotun3D and Additive Manufacturing - Renaissance for Powder Technology, Challenge for Advanced Composites and HKP

Additive Manufacturing (AM) became a brilliant and cost-effective technique for manufacturing complex shapes in small part-quantities based on materials suitable for the processability. The more this powder-based consolidation technique matures, the more higher performance materials are demanded. This includes post-processing such as HIP for structural improvements of the bulk and also shaping during or after powder manufacturing to achieve suitable spherical shape at controlled PSD resulting e. g. in a good flow-ability.
Within the ongoing Nanotun3D EU-H2020 undertaking (grant agreement 685952), 9 partners from 5 countries target a novel dispersion strengthened Ti-6Al-4V-0,5dps powder/bulk where the nanostructured powder composites are "pre-consolidated" by HIP and HP and subsequently atomized by EIGA for AM-processes SLM and EBM. Dispersoids (dps) are Y2O3, SiC and core-shell SiC@TiO2. Zoz, as the manufacturer high kinetic processing equipment (HKP, Simoloyer® etal.) and nanostructured materials (powder and bulk from HKP-processing) is contributing powder-manufacturing and pre-consolidation. If this project will be successful, it can open a wide range of new applications for HKP in advanced composites. The presentation reflects the current promising status from the view of Zoz.

P28 **TDC Corporation**
Rifu/Sendai, Japan

**Yuko Akabane**
CEO & President

### TDC's precision technologies

On top of achieving a surface roughness of Ra 1nm, our polishing technology can achieve a wide variety of requirements for ultra-precision, such as flatness, parallelism, tolerance, angle, and roundness. We are fully equipped with highly reliable measurement devices, allowing us to achieve consistency in quality. We are also eagerly developing new technologies that were previously seen as impossible. For example, we succeeded in developing continuous polishing of metal foil that is dozens of micro thick and several hundred meters long. We also succeeded in developing a polishing technology that achieves a surface roughness in the class of a silicon wafer on the surface of a cylinder, making a global contribution to the field of nanoimprinting. TDC Corporation provides the most reliable quality through our unrivaled technology, rich human resources, and unique production system.

P29 **University of Udine**
**DPIA Dipartimento Politecnico di Ingegneria e Architettura**
Udine, Italy

**Prof. Dr. Fabio Miani**
Associate Professor of Metallurgy

### Towards additive manufacturing for nanomaterials

We present our work in the study and application of nanophase materials to additive manufacturing.
We consider recent work on the metal alloys for fusion-based additive manufacturing, with a simple procedure on the grain size on solidification related to Calphad based calculations. This links data obtained with the solid fraction of solidifying materials to their evolution ( Kozlov / Schmid-Fetzer approach) and defect generation ( Kou approach). Limitations on the commercially available thermodynamic Calphad based thermodynamic databases are presented and discussed. This is then applied to the processes we are developing in the special light of the addition of nanophase powders during liquid processing. Preliminary results obtained up to date will be discussed and compared to the calculations of our approach.

P30 **Universidad Nacional de Tucumán**
**Facultad de Ciencias Exactas y Tecnología (FACET)**
S. M. de Tucumán, Argentina

**Prof. Mónica Tirado**
Director Nanomaterials Lab.

### ZnO nanostructures - growth, properties and their application in devices

Nanomaterial properties depend not only on their size but also on their superficial state like ZnO nanostructures and ZnO nanowires (ZnO, NWs). Thus we devoted to controlling optical, electrical and chemical properties through the modification of their surfaces with organic and inorganic materials. ZnO is one of the most important and promising semiconductor, e. g. having a broad band gap, excitons possess ligation energies higher than those of thermal energy showing piezoelectricity and high isoelectric point. Understanding and controlling superficial processes affecting (1) gaps and electrons recombination, thus optical emission and absorption, (2) electrochemical processes are important for their application on luminescent emitting devices (LEDs, lasers), optoelectronic and electrical properties to apply in solar cell electrode and amperometric biosensors. Details given in the fabrication of ZnO nanostructures and NWs from vapour and colloids (electrophoretic and dip-coating deposition) and methods developed in relation to ZnO NWs transference from the growing substrate to more convenient surfaces. Discussing photo and electroluminescence in ZnO/MgO NWs structures and devices in ZnO NWs/PEDOT and ZnO with Ni films, absorption and optoelectronic properties in ZnO nanostructures sensitized by Ru and photoluminescence and electrochemical measurements in ZnO NWs/GOx (GOx=oxidase glucose).

P31

**Advanced Research Centre (ARCI)**
**Centre for Nanomaterials**
Hyderabad, India

**Dr. Ravula Vijay**
Scientist 'F' and Team Leader

### Age hardening behavior of ODS-9Cr ferritic-martensitic and ODS-18Cr ferritic steels

Oxide dispersion strengthened (ODS) steels are potential candidates for high temperature applications, such as, blanket materials for fusion reactors, fuel cladding materials for Gen-IV fission reactors and blades for gas and ultra-super critical steam turbines due to superior properties, such as, high temperature strength and resistance to creep, corrosion, oxidation and neutron irradiation. The ODS steels are based on Fe-(9-18%)Cr-2W-0.2Ti matrix with yttria as dispersoids. Addition of Ti to the yttria containing steel is known to refine the size and increase the number density and volume fraction of dispersoids by forming Y-Ti-O complex oxides. The performance of ODS steels depends on the composition, concentration, stability, size, spacing and distribution of dispersoids in the matrix. It is reported that the size of Y-Ti-O nanodispersoids is stable upto 850°C and increases beyond this temperature. The emphasis of this work was aimed at developing a comprehensive understanding of effect of annealing temperature (850-1250°C) on the microstructural and the resultant mechanical properties of ODS-9Cr ferritic-martensitic and ODS-18Cr ferritic steels.

P32

**Fraunhofer Institute for Silicate Research - ISC**
**Project Group Materials Recycling and Resource Strategies, IWKS**
Alzenau, Germany

**Dr. Gert Homm**
Head of Dept. Urban Mining

### Recycling of valuable metals from steel mill dusts by mechano-chemical treatment

Zinc is a crucial element for the corrosion protection of steel. During the recycling of zinc plated steel almost the entire amount of zinc ends up in the filter dust of the steel mill. Unfortunately in Germany more than 65% of the resulting filter dusts are deposited. This does not only mean the loss of money due to increasing landfill costs but also an annual zinc loss of about 48000 metric tons.
In a DBU-funded project the Zoz GmbH and Fraunhofer IWKS are investigating a method for the efficient recovery of valuable metals from filter dusts. Besides the novel concept, first results are presented on the recovery of zinc by means of mechano-chemical leaching - a very elegant and cost effective hydro metallurgical method.

P34

**ZBT GmbH**
**the fuel cell research center**
Duisburg, Germany

**Dr. Ivan Radev**
Project manager
“Electrochemistry & Coating”

### High-Performance and Durable Low Cost PEM Fuel Cell Electrodes based on Novel HGS Electrocatalysts

Low temperature PEM fuel cells (LT-PEMFC) are highly efficient and high power density chemical to electricity converters that operate at temperatures below 100°C. Unlike batteries, fuel cells do not contain environmental hazardous products, the fuel and oxidant are externally supplied and they continuously generate electricity as long as a source of hydrogen and oxygen (air) is supplied. Fuel cells are quiet, pollution-free, and up to two times more efficient than combustion technologies. A fuel cell system can be a truly zero-emission source of electricity when hydrogen is produced from nonpolluting sources. Therefore, LT-PEMFCs are an attractive alternative to the internal combustion engines and batteries for mobile applications. A further cost reduction of LT-PEMFC is required for broader commercialization of this technology. Despite many studies on non-noble materials, platinum remains the most active catalyst and is therefore considered as the state-of-the-art electrocatalyst for the sluggish cathode reaction. While activity is a good discriminating parameter to screen between different electrocatalysts, an equally important parameter for their actual industrial application is their durability. Hence, current research efforts are directed toward lowering its use in LT-PEMFCs and increasing the durability via optimization of: (i) catalyst support; (ii) catalyst and (iii) LT-PEMFC catalyst layer structures.

*(shortened - pls. see proceedings)*


# DEVELOPMENT OF COMPOSITE CONCRETE WALLS FOR THE PHYSICAL PROTECTION (SHIELDING) OF MILITARY BUILDINGS.

10th International Symposium on
10th German-Japanese Symposium on

# Exhibitors

# Alphabetical list of exhibitors

| | | | |
|---|---|---|---|
| AIDIMME | ES-46980 Paterna | Spain | E01 |
| Bundesvereinigung Binationaler Gesellschaften e. V. | D-36251 Bad Hersfeld | Germany | E02 |
| CIITEC-IPN | Mexico D.F. 02250 | México | E03 |
| Cluster NanoMikroWerkstoffePhotonik.NRW | D-40239 Duesseldorf | Germany | E04 |
| Continental Reifen Deutschland GmbH | D-30165 Hannover | Germany | E05 |
| Deaguntech - dpert 3D | Gyeongsangnam-do 51389 | Korea | E06 |
| Deutscher Arbeitgeberverband e. V. | D-65195 Wiesbaden | Germany | E07 |
| Elektrotechnik Schröder | D-57482 Wenden | Germany | E08 |
| EURECA Cluster Metallurgy Europe | D-89081 Ulm | Germany | E09 |
| Farbe und Lack, Vincentz Network GmbH & Co. KG | D-30175 Hannover | Germany | E10 |
| Fraunhofer ISC | D-63755 Alzenau | Germany | E11 |
| GM Rajesh Aviation / Night Queen Airlines / NQA | NL- 1355 HT Almere-Haven | Netherlands | E12 |
| Hana AMT Co. | 642-1 Cheongwon-gun | Korea | E13 |
| Heatlab Inc. | 432071 Ulyanovsk | Russian Federation | E14 |
| Helmholtz-Zentrum Geesthacht | D-21502 Geesthacht | Germany | E15 |
| HoDforming | D-40231 Duesseldorf | Germany | E16 |
| Höganäs AB | SE-26383 Höganäs | Sweden | E17 |
| HuK Umweltlabor GmbH | D-57482 Wenden | Germany | E18 |
| Jiangsu Sino-GIC Co., Ltd | Changzhou 213000 | P. R. China | E19 |

| | | | |
|---|---|---|---|
| KAMI, Korea Advanced Machinery Inc. | 153-789 Seoul | Korea | E20 |
| Karlsruhe Institute of Technology - KIT | D-76131 Karlsruhe | Germany | E21 |
| Korea Magnesium Technology Research Association | 641-465 Changwon City | Korea | E22 |
| Kunming University of Science and Technology | 650093 Kunming, Yunnan | P.R. China | E23 |
| MATSYS Inc. | Sterling VA 20164 | USA | E24 |
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| Nanobay NB GmbH | D-48599 Gronau | Germany | E26 |
| Poongsan Holdings Corp. | Seoul 120-837 | Korea | E27 |
| Quintus Technologies AB | SE-72166 Västeras | Sweden | E28 |
| RHP-Technology GmbH | A-2444 Seibersdorf | Austria | E29 |
| SmartMembranes GmbH | D-06120 Halle (Saale) | Germany | E30 |
| TDC Corporation | Tokyo 101-0052 | Japan | E31 |
| Ulyanovsk Center of Technology Transfer, LLC | 432071 Ulyanovsk | Russian Federation | E32 |
| Zoz Group | D-57482 Wenden | Germany | E33 |
| 3D-DaS | D-57462 Olpe | Germany | E34 |
| 3D PRO - 3D Printing Research Organization | 641-465 Changwon City | Korea | E35 |
| Zoz Technology Center (Excursion 1) | D-57462 Olpe | Germany | -50 |
| Zoz Central Siegen (Excursion 2) | D-57072 Siegen | Germany | -51 |

# 12th German-International Symposium on Nanostructures

March 1-3, 2020
Wenden, Germany

## Ceremonial Lecture at OZ-20

Prof. Dr. Friedrich Wagner, former Director of the Max-Planck-Institute for Plasma Physics; Prof. em. Ernst-Moritz-Arndt University, Greifswald; President of the European Physical Society 2007-09.

*Prof. Dr. Friedrich Wagner at the fusion-experiment "Wendelstein 7-X"*

OZ-Symposium is held annually since 2008. Until OZ-18 alternating between Germany and Japan, the symposium in the future will be alternating between Germany and global technology-open sites throughout the world. For 2019 and 2021, Korea, Mexico and Sri Lanka are in vision. Decision expected during OZ-18.

| [OZ-19] | [OZ-20] | [OZ-21] |
|---|---|---|
| **March 3-5, 2019<br>Korea, Mexico or Sri Lanka** | **March 1-3, 2020<br>Germany** | **Feb. 28 - March 2, 2021<br>Korea, Mexico or Sri Lanka** |

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