19 PLANSEE SEMINAR 2017

International Conference on Refractory Metals and Hard Materials

Reutte/Austria
29 May – 2 June, 2017

Final Programme
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Lorenz S. Sigl, Heinrich Kestler, Andreas Pilz, Dénes Széchényi
Welcome to the 19th Plansee Seminar!

I am greatly honored by the many contributions we received in response to our call for papers. The large number of 216 contributions clearly emphasizes your continued interest in the science and technology of refractory metals and hard materials, more than sixty years after the first Plansee Seminar was held in 1952.

The presentations of the 19th Plansee Seminar, both, lectures and posters, cover all aspects of refractory metals and hard materials. Starting with global overviews of markets and R&D trends, they address all disciplines of our industry: from innovations in powder production to processing, materials and their applications, from modeling and characterization to recycling as well as new manufacturing technologies like cold gas spraying and additive manufacturing.

We are very much looking forward to this Seminar as a platform of scientific and technological exchange as well as a lively meeting-place to establish and foster contacts and relationships in the refractory metals and hard materials community.

I am grateful for your continued interest and commitment to this conference and encourage you to bring in your expertise, be it by presenting a paper or by participating in the discussions.

Let me wish you an enriching seminar week in an inspiring atmosphere!

Heinrich Kestler
Secretary of the Plansee Seminar
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Oral Sessions

Monday, 29 May, 08:30 – 10:00  Opening Ceremony

08:30  Musical Welcome  Plansee Werksmusik
09:30  Allegro from Serenade No. 13  Chamber Orchestra Reutte
W. A. Mozart
Conductor: Tobias Lämmle
Opening Address  Karlheinz Wex
Member of the Executive Board, Plansee Holding AG
Capriol Suite  Chamber Orchestra Reutte
P. Warlock
Welcome Address  Lorenz S. Sigl
Chairman of the Seminar
Concerto Grosso No. 1  Chamber Orchestra Reutte
E. Bloch

Monday, 29 May, 10:00 – 12:00  Opening Session

Chair: Sigl L.S., Plansee SE, Austria
Kestler H., Plansee SE, Austria
Location: Walter Schwarzkopf Hall, WSH
10:00 OS 1  Alice and the elements of innovation
Raynor M.E.*
*Monitor Deloitte, USA
10:40 OS 2  Basic development in refractory metal markets
Lausecker U.*
*Plansee SE, Austria
11:20 OS 3  Global trends in hard materials
*Kennametal Inc., USA
12:00 – 14:00  Lunch Break

Monday, 29 May, 14:30 – 15:40  Hard Materials – Applications

Chair: Schleinkofer U., CERATIZIT Austria GmbH, Austria
Norgren S., Sandvik & Uppsala University, Sweden
Location: Walter Schwarzkopf Hall, WSH
14:00 HM 1  HPC-Milling of WC-Co cemented carbides with PCD
Hintze W.*, Steinbach S.*, Hertel C.*, Kähler F.*
*Hamburg University of Technology, Germany
14:20 HM 2  Investigation of wear resistance of coated PcBN turning tools for hard machining
*Technical University of Berlin, Germany
**GFE - society of production engineering Schmalkalden, Germany
Oral Sessions

14:40  HM 3  Coatings and tool materials for efficient gear manufacturing
       Eriksson A.*, Arndt M.*
       *Oerlikon Surface Solutions AG, Liechtenstein

15:00  HM 4  Interaction between cemented carbide and Ti6Al4V alloy in cryogenic machining
       Lattemann M.*, Coronel E.*, Garcia J.*, Sadik I.*
       *Sandvik Coromant, Sweden

15:20  HM 5  Characterization of the corrosion behaviour of cemented tungsten carbides in chloride containing solutions at elevated temperatures
       Kube R.*, Sarmiento Klapper H.*, Stevens J.*
       *Baker Hughes, Germany

15:40 – 16:10  Break

Monday, 29 May, 16:10 – 17:40  Refractory Metals – Applications

Chair:  Leichtfried Gerhard, Universität Innsbruck, Austria
        Knabl Wolfram, Plansee SE, Austria
Location:  Walter Schwarzkopf Hall, WSH

16:10  RM 1  Applications of refractory metals in medical imaging systems
       Fritzler S.*, Bernhardt J.*
       *Siemens Healthcare GmbH, Germany

16:40  RM 2  Carbon doping - A key for the substitute of thoriated tungsten
       *Plansee SE, Austria
       **Osram GmbH, Germany
       ***Ruhr-Universität-Bochum, Germany

17:00  RM 3  Optimization of CuCr contact materials for vacuum interrupters
       Hauf U.*, Feilbach A.**, Böning M.***, Hinrichsen V.**, Müller F.E.H.***, Heilmayer M.*
       *Karlsruhe Institute of Technology, Germany
       **Technical University of Darmstadt, Germany
       ***Plansee Powertech AG, Switzerland

7:20  RM 4  Development of bio-compatible refractory Ti/Nb(Ta) alloys for application in patient-specific orthopaedic implants
       *H.C. Starck Tantalum and Niobium GmbH, Germany
       **University of Rostock, Germany

17:40  End of sessions
## Oral Sessions

**Tuesday, 30 May, 08:30 – 10:00  Hard Materials – Materials 1**

**Chair:** Prakash Leo, WTP Materials Engineering, Germany  
Magin Michael, CERATIZIT Luxembourg S.à.r.l., Luxembourg  
**Location:** Walter Schwarzkopf Hall, WSH

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*Element Six GmbH, Germany; National University of Science and Technology MISiS, Russia  
**Element Six GmbH, Germany |
| 09:00 | HM 7    | Ultra-fine grained cemented carbide by the addition of fine Ti(C,N) particles | Matsubara H.*, Takada M.*  
*Tohoku University, Japan |
| 09:20 | HM 8    | Grain growth inhibition of hardmetals during initial heat-up          | Pötschke J.*, Gestrich T.*, Richter V.*  
*Fraunhofer Institute for Ceramic Technologies and Systems IKTS, Germany |
| 09:40 | HM 9    | On gradient formation in alternative binder cemented carbides         | Norgren S.*, Garcia J.*  
*Sandvik Coromant, Sweden |

**10:00 – 10:30 Break**

**Tuesday, 30 May, 10:30 – 12:10  Hard Materials – Materials 2**

**Chair:** Vleugels Jozef, Katholieke Universiteit Leuven, Belgium  
Bose Animesh, Desktop Metal, USA  
**Location:** Walter Schwarzkopf Hall, WSH

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*Beijing University of Technology, China |
*Ceit-IK4, Spain  
**FMD CARBIDE, Spain |
| 11:10 | HM 12   | Effects of doping WC-Co hardmetals with Mo and Mo2C                  | Jewett T.*  
*Global Tungsten & Powders Corp., USA |
| 11:30 | HM 13   | NbC grain growth control and mechanical properties of Ni bonded NbC cermets prepared by vacuum liquid phase sintering | Huang S.*, Vleugels J.*, Mohrbacher H.*, Woydt M.**  
*Katholieke Universiteit Leuven, Belgium  
**Federal Institute for Materials Research and Testing, Germany |
| 11:50 | HM 14   | High entropy alloy binders in gradient sintered hardmetal            | Linder D.*, Holmström E.**, Norgren S.**  
*KTH Royal Institute of Technology, Sweden  
**Sandvik Coromant, Sweden |

**12:10 – 14:00 Lunch Break**
Oral Sessions

Tuesday, 30 May, 14:00 – 15:40  Refractory Metals – Materials 1

Chair: Song Xiaoyan, Beijing University of Technology, China
       Johnson John L., Elmet Technologies LLC, USA
Location: Walter Schwarzkopf Hall, WISH

14:00  RM 5  Physical metallurgy of the molybdenum base alloy MHC
         Lang D.*, Schatte J.*, Knabl W.*, Clemens H.**
         *Plansee SE, Austria
         **University of Leoben, Austria

14:20  RM 6  Particle-stimulated nucleation of recrystallization in hot-pressed molybdenum-based MZ-17 alloy
         Silva E.Z.*, Kestler H.**, Sandim H.*
         *University of São Paulo, Brazil
         **Plansee SE, Austria

14:40  RM 7  Phase transformations in HfNbTiVZr high-entropy alloys during annealing
         *Uppsala University, Sweden

15:00  RM 8  Nanolaminated ternary carbide (MAX phase) materials for high temperature applications
         *Katholieke Universiteit Leuven - SCK CEN, Belgium
         **Katholieke Universiteit Leuven, Belgium
         ***SCK CEN, Belgium

15:20  RM 9  Ductilisation of tungsten (W) through cold-rolling
         Hoffmann A.***, Rieth M.*
         *Karlsruhe Institute of Technology, Germany
         **Plansee SE, Austria
         ***Plansee SE, Austria

15:40 – 16:10  Break

Tuesday, 30 May, 14:00 – 15:40  Special Interest Session: Hard Materials – Micromechanics

Chair: Broeckmann Christoph, RWTH Aachen, Germany
       Sigl Lorenz S., Plansee SE, Austria
Location: Lecture Hall

14:00  HM 35  Assessing WC-WC interfaces in WC-Co hardmetals through micro-beam testing
          *Ceit-IK4 and University of Navarra, Spain

14:20  HM 36  Revealing mechanisms of abrasion in WC/Co hardmetals by in situ scratch testing
          Gee M.*, Nunn J.*, Mingard K.*, Roebuck B.*, Jones H.*
          *National Physical Laboratory, United Kingdom

14:40  HM 37  Small scale mechanical response of WC-Co cemented carbides
          *Universitat Politècnica de Catalunya, Spain
          **Sandvik Hyperion, United Kingdom
Oral Sessions

15:00 HM 38 Annealing effect on the fracture toughness of CrN/TiN superlattices
Hahn R.*, Bartosik M.*, Arndt M.**, Polcik P.***, Mayrhofer P.H.*
*CDL-AOS at Technical University of Vienna, Austria
**Oerlikon Surface Solutions AG, Liechtenstein
***Plansee Composite Materials GmbH, Germany

15:20 HM 39 Investigations of micro-mechanical properties of Ti(C,N) and Zr(C,N) coatings
*Saarland University, Germany
**Sandvik Coromant, Sweden

15:40 – 16:10 Break

Tuesday, 30 May, 16:10 – 17:50 Refractory Metals – Materials 2

Chair: Heilmaier Martin, Karlsruhe Institut of Technology, Germany
Granzer Thomas, Plansee Composite Materials GmbH, Germany
Location: Walter Schwarzkopf Hall, WSH

16:10 RM 10 Environmental resistant Mo-Si-B based coatings
Perepezko J.H.*, Sossaman T.A.*, Taylor M.*
*The University of Wisconsin-Madison, USA

16:30 RM 11 Influence of B content on microstructure and properties of fine-grained lanthanum oxide-doped Mo-Si-B alloys
Li R.*, Li B.**, Ren S.*, Zhang G.*, Liu D.***, Sun Y.***
*Xi’an University of Technology, China
**Northwest Institute for Non-ferrous Metal Research, China
***Jinduicheng Molybdenum Co., Ltd., China

16:50 RM 12 Microstructural analysis and high temperature creep testing of Mo-9Si-8B-xAl-yGe alloys
Kellner P.*, Rainer V.*, Uwe G.*
*University Bayreuth, Germany

17:10 RM 14 Ti-Al-N/Mo-Si-B multilayers: An architectural design for high temperature oxidation resistant hard coatings
*CDL-AOS at Technical University of Vienna, Austria
**Technical University of Vienna, Austria
***Plansee Composite Materials GmbH, Germany
****Oerlikon Surface Solutions AG, Liechtenstein

17:30 RM 13 Effect of the addition of Nb on mechanical properties in Mo-Si-B alloy
*Hanyang University, South Korea

17:50 End of sessions
Oral Sessions

Tuesday, 30 May, 16:10 – 17:50   Special Interest Session: Hard Materials – Mechanical Properties

Chair: Fang Zhigang Zak, University of Utah, USA
Gee Mark, National Physical Laboratory, United Kingdom
Location: Lecture Hall

16:10   HM 40 Strength and reliability of WC-Co cemented carbides: Understanding microstructural effects on the basis of R-curve behavior and fractography
*Sandvik Mining and Construction Tools AB, Sweden
**Universitat Politècnica de Catalunya, Spain
***Universidad de Sevilla, Spain
****Sandvik Hyperion, United Kingdom

16:30   HM 41 Mechanisms of plastic deformation in WC-Co and WC-Ni-Fe turning inserts
Toller L.*, Norgren S.**
*Uppsala University, Sweden
**Sandvik Coromant, Uppsala University, Sweden

16:50   HM 42 Strengthening effects and plastic accommodation in ultrafine and nanocrystalline cemented carbides
Song X.*, Liu X.*, Feng Q.*, Wang H.*, Liu X.*
*Beijing University of Technology, China

17:10   HM 43 Cyclic plastic deformation behaviour of WC-Co hard metals at elevated temperatures
*Materials Center Leoben Forschung GmbH, Austria
**CERATIZIT Austria GmbH, Austria

17:30   HM 44 Design of coated cemented carbides with improved comb crack resistance
*Sandvik Coromant, Sweden
**University of São Paulo, Brazil

17:50   End of sessions
Oral Sessions

Wednesday, 31 May, 08:30 – 10:10  Refractory Metals – Materials 3

Chair: Perepezko John H., The University of Wisconsin-Madison, USA
      Cury Rafael, PLANSEE Tungsten Alloys, France
Location: Walter Schwarzkopf Hall, WSH

08:30  RM 15  Toward a smart molybdenum technology: Next generation superconducting wires
          Seeber B.*
          *scMetrology SARL, Switzerland

08:50  RM 16  Niobium alloys for the chemical process industry
          Aimone P.*, Yang M.*
          "H.C. Starck, Inc., USA

09:10  RM 17  Microstructure development of chromium-rich Cr-Si-Ge alloys
          Ulrich A.S.*, Soleimani Dorcheh A.*, Galetz M.C.*
          "DECHHEMA-Forschungsinstitut, Germany

09:30  RM 18  Self-passivating tungsten alloys of the system W-Cr-Y for high temperature applications
          *Celt-IK4, Spain
          **Max-Planck-Institut für Plasmaphysik, Germany
          ***Forschungszentrum Jülich GmbH, Germany
          ****Polytechnic University of Madrid, Spain

09:50  RM 19  Development of advanced W-based alloy tool for FSW of austenitic stainless steel
          Tomohiro T.*, Akihiko I.*
          *Allied Materials, Japan
          **Tohoku University, Japan
          ***Nippon ITF, Japan

10:10  Break

Wednesday, 31 May, 10:40 – 12:20  Refractory Metals – Characterization

Chair: Clemens Helmut, Montanuniversität Leoben, Austria
       Hoose André, Plansee SE, Austria
Location: Walter Schwarzkopf Hall, WSH

10:40  RM 20  A method for measuring the high temperature emissivity of refractory metal surfaces
          *Plansee SE, Austria

11:00  RM 21  Interaction of precipitation, recovery and recrystallization in the Mo-Hf-C alloy MHC
          studied by multipass compression tests
          *University of Leoben, Austria
          **Plansee SE, Austria

11:20  RM 22  Microstructure and mechanical properties of large tungsten component for radiation shielding
          Liu C.*, Jiang X.*, Song J.*, Yu Y.*
          *Xiamen Tungsten Co. Ltd., China
Oral Sessions

11:40  RM 23  Characterization of neutron irradiated tungsten by transmission electron microscopy
        *Karlsruhe Institute of Technology, Germany
        **University of Oxford, United Kingdom

12:00  RM 24  Recrystallization and composition dependent thermal fatigue response of different tungsten grades
        *Forschungszentrum Jülich GmbH, Germany
        **Karlsruhe Institute of Technology, Germany

12:20 – 14:00 Lunch Break

Wednesday, 31 May, 14:00 – 15:40  Hard Materials – Characterization

Chair:  Llanes Luis, Universitat Politècnica de Catalunya, Spain
        Tkadletz Michael, Montanuniversität Leoben, Austria
Location:  Walter Schwarzkopf Hall, WSH

14:00  HM 15  Visualisation and measurement of hardmetal microstructures in 3D
        *National Physical Laboratory, United Kingdom

14:20  HM 16  Influence of sintering parameters on micro-scale mechanical and tribological behavior
        of niobium carbides
        *University of São Paulo, Brazil

14:40  HM 17  High resolution STEM investigation of interface layers in cemented carbides
        Meingast A.*, Coronel E.*, Blomqvist A.*, Norgren S.*, Wahnström G.*, Lattemann M.*
        *Sandvik Coromant, Sweden
        **Chalmers University of Technology, Sweden

15:00  HM 18  Influence of microstructure on the thermal conductivity of cemented carbides
        Ono A.*, Okada K.*, Homma H.*, Nakanishi Y.*
        *Mitsubishi Materials Corporation, Japan

15:20  HM 19  Thermophysical properties of Co-free WC-FeCr hardmetals
        *Imperial College London, United Kingdom
        **Sandvik Hyperion, United Kingdom
        ***Tokamak Energy, United Kingdom

15:40 – 16:10 Break
Oral Sessions

Wednesday, 31 May, 16:10 – 17:30  Recycling and Tungsten Chemistry

Chair: Trasorras Juan R.L., Global Tungsten & Powders Corp., USA
Antrekowitsch Helmut, University of Leoben, Austria
Location: Walter Schwarzkopf Hall, WSH

16:10  RC 1  Zinc-reclaim of refractory materials: mechanisms and limitations
Weissensteiner C.M.*, Mühlbauer G.**, Qvick J.***, Schubert W.-D.*, Edtmaier C.*
*Vienna University of Technology, Austria
**Wolfram Bergbau und Hütten AG, Austria
***Seco Tools AB, Sweden

16:30  RC 2  Effect of powder particle size distribution on the properties of submicron hard metal made of WC-Co zinc reclaim powders
*Tikomet Oy, Finland
**Global Tungsten & Powders Corp., USA

16:50  RC 3  Leaching kinetics for semi-direct recycling of drill bits
Kerschbaumer C.*, Luidold S.*, Wolfe T.**, Smith A.**
*University of Leoben, Austria
**Global Tungsten & Powders Corp., USA

17:10  RC 4  Formation, stability and application of tungstates, tungsten oxides and tungsten bronzes
Szilágyi I.M.*
*Budapest University of Technology and Economics, Hungary

17:30  End of sessions
Oral Sessions

Thursday, 1 June, 08:30 – 10:10  Refractory Metals – Additive Manufacturing

Chair:  Kieback Bernd, Fraunhofer IFAM /TU Dresden, Germany
Kestler Heinrich, Plansee SE, Austria
Location:  Walter Schwarzkopf Hall, WSH

08:30  RM 25  Selective laser melting of tungsten and tungsten alloys
*Katholieke Universiteit Leuven, Belgium
**3D Systems, Belgium

08:50  RM 26  Fundamental analysis of the influence of powder characteristics in selective laser melting of molybdenum based on a multi-physical simulation model
*Plansee SE, Austria

09:10  RM 27  Comparison of LCAC and PM Mo deposited using Sciaky EBAM
Stawov M.*
*H.C. Starck, Inc., USA

09:30  RM 28  Wire + Arc additive manufacturing: Towards a new way of producing large-scale refractory metals component
Marinelli G.*, Martina F.*, Ganguly S.*, Williams S.*
*Cranfield University, United Kingdom

09:50  RM 29  Cold spray of tungsten powders above and below the DBTT
Smid I.*, Schreiber J.*, Eden T.*
*Penn State University, USA

10:10 – 10:40  Break

Thursday, 1 June, 08:30 – 10:20  Special Interest Session: Hard Materials – Chemical Vapor Deposition

Chair:  Winkler Jörg, Plansee SE, Austria
Holzschuh Helga, SuCoTec AG, Switzerland
Location:  Lecture Hall

08:30  HM 45  CVD TiAIN – Development and challenges for use in mass production
*CERATIZIT Austria GmbH, Austria
**SucoTec AG, Switzerland

09:00  HM 46  Self-organized TiAIN HR-CVD coatings with functionalized nanolamellar microstructures
*BOEHLERIT GmbH & Co KG, Austria
**University of Leoben, Austria
Oral Sessions

09:20 HM 47  
CVD TiAlN technology - Coating properties and applications  
Vogiatzis S.*, Papageorgiou V.*, Strakov H.*, Auger M.*  
*IHI Ionbond AG, Switzerland

09:40 HM 48  
Influence of the Al content on mechanical properties of CVD aluminum titanium nitride coatings  
*Mitsubishi Materials Corporation, Japan

10:00 HM 49  
Thermal stability of Al-rich c-AlxTi1-xN coatings prepared by LP-CVD  
Paseuth A.*, Miura A.**, Tadanaga K.**, Yamagata K.*  
*Sumitomo Electric Hardmetal Corp., Japan  
**Hokkaido University, Japan

10:20 – 10:50 Break

Thursday, 1 June, 10:40 – 12:20  
Refractory Metals – Processing

Chair:  
Tabernig Bernhard, Plansee SE, Austria  
Leichtfried Gerhard, Universität Innsbruck, Austria

Location:  
Walter Schwarzkopf Hall, WSH

10:40 RM 30  
How gravity influences accuracy in liquid phase sintering  
German R.*, Olevsky E.*  
*San Diego State University, USA

11:00 RM 31  
Coarsening, densification, and grain growth during sintering of nanosized tungsten powder  
Fang Z.*, Ren C.*, Koopman M.*, Wang H.**  
*University of Utah, USA  
**Kennametal Inc., USA

11:20 RM 33  
Development of tungsten components for langmuir probes in ITER by metal injection molding  
*Xiamen Tungsten Co., Ltd., China  
**Southwestern Institute of Physics, China

11:40 RM 34  
Development and industrialization of a tungsten heavy metal feedstock for metal injection molding based on BASF's CATAMOLD™ technology  
Loeber O.*, Bloemacher M.*, Fleischmann S.*, Wallot J.*  
*BASF SE, Germany

12:00 RM 85  
Traditional and additive manufacturing of a new tungsten heavy alloy alternative  
*Desktop Metal, Inc., USA  
**Desktop Metal, Inc., Massachusetts Institute of Technology, USA  
***Desktop Metal, Inc., Yale University, USA  
****Veloxint Corporation, USA

12:20 – 14:00 Lunch Break
Oral Sessions

Thursday, 1 June, 10:50 – 12:10   Special Interest Session: Hard Materials – Physical Vapor Deposition

Chair:      Mayrhofer Paul, TU Wien, Austria  
           Czettl Christoph, CERATIZIT Austria GmbH, Austria  
Location:  Lecture Hall

10:50   HM 50   Cerium doping of Ti-Al-N coatings for excellent thermal stability and oxidation resistance
           *Technical University of Vienna, Austria
           **Plansee Composite Materials GmbH, Austria
           ***CDL-AOS at Technical University of Vienna, Austria

11:00   HM 51   Thermal stability and mechanical properties of Ti-Al-B-N thin films
           Moraes V.*, Bolvardi H.**, Kolozsvári S.***, Riedl H.****, Mayrhofer P.H.*****
           *CDL-AOS at Technical University of Vienna, Austria
           **Oerlikon Balzers Surface Solutions AG, Liechtenstein
           ***Plansee Composite Materials GmbH, Germany
           ****Technical University of Vienna, Austria

11:30   HM 52   Influence of Ta-addition and layer arrangement on the structure, mechanical and thermal of TiAlN coatings
           Yang Y.*, Xu Y.X.*, Chen L.*, Du Y.*
           *Central South University, China

12:10 – 14:00   Lunch Break

Thursday, 1 June, 14:00 – 15:40   Hard Materials – Coating

Chair:      Pitonak Reinhard, Boehlerit GmbH & Co. KG, Austria  
           Polcik Peter, Plansee Composite Materials GmbH, Germany
Location:  Walter Schwarzkopf Hall, WSH

14:00   HM 20   Powder, target, coating - Design of dedicated interfaces
           Ramm J.*****; Rudigier H.******, Von Allmen K.*, Widrig B.*****
           *Empa - Swiss Federal Laboratories for Materials Science and Technology, Switzerland
           **ETH Zürich, Switzerland
           ***Oerlikon Metco AG, Switzerland
           ****Plansee Composite Materials GmbH, Germany
           *****Oerlikon Surface Solutions AG, Liechtenstein
## Oral Sessions

| Time   | Session | Title                                                                                           | Authors                                                                                       | Affiliations                                      |
|--------|---------|-------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|
|        |         | *Kennametal Inc., USA                                                                            |                                                                                                |
| 14:40  | HM 22   | Knowledge based coating design of CVD TiN-TiBN-TiB2 architecture                                 | Czettl C.*, Thurner J.*, Schleineker U.*                                                       |
|        |         | *CERATIZIT Austria GmbH, Austria                                                                 |
| 15:00  | HM 23   | Fracture toughness of Ti-Si-N nanocomposite thin films                                          | Bartosik M.*, Hahn R.*, Amdt M.*, Polcik P.*, Mayrhofer P.H.*                                 |
|        |         | Technical University of Vienna, CDL-AOS at Technical University of Vienna, Austria               |
|        |         | CDL-AOS at Technical University of Vienna, Austria                                               |
|        |         | Oerlikon Surface Solutions AG, Liechtenstein                                                    |
|        |         | Plansee Composite Materials GmbH, Germany                                                        |
|        |         | Beijing University of Technology, China                                                          |
| 15:40  |         | Break                                                                                           |                                                                                                |
| 15:40  |         | End of sessions                                                                                 |                                                                                                |

### Thursday, 1 June, 16:10 – 17:50 Hard Material – Processes

**Chair:** Sánchez-Moreno José Manuel, CEIT-Centro de Estudios e Investigaciones, Spain  
Schleineker Uwe, CERATIZIT Austria GmbH, Austria  

**Location:** Walter Schwarzkopf Hall, WSH

| Time   | Session | Title                                                                                           | Authors                                                                                       | Affiliations                                      |
|--------|---------|-------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|
| 16:10  | HM 25   | Predicting flowability of powders based on the specific surface area distribution               | Troescher N.*, Enneti R.*, Morgen R.*, Trasorras J.R.L.+                                           |
|        |         | Pennsylvania State University, USA                                                               |
|        |         | **Global Tungsten & Powders Corp., USA                                                            |
|        |         | Fraunhofer Institute for Mechanics of Materials IWM, Germany                                      |
| 16:50  | HM 27   | Impact of crystal defects on the grain growth of cemented carbides                               | Weidow J.*, Ekström E.*, Kritikos M.*, Norgren S.***                                               |
|        |         | Chalmers University of Technology, Sweden                                                        |
|        |         | **Royal Institute of Technology, Sweden                                                          |
|        |         | ***Sandvik Coromant, Sweden                                                                     |
|        |         | ****Sandvik, Sweden                                                                               |
|        |         | Fraunhofer Institute for Ceramic Technologies and Systems IKTS, Germany                           |
|        |         | *University Carlos III of Madrid, Spain                                                          |
|        |         | **Hispano Italiana de Revestimientos S.A., Spain                                                |
|        |         | ***CSIC, Spain                                                                                    |
|        |         | ****Materials Center Leoben Forschung GmbH, Austria                                              |
|        |         | *****University of Leoben, Austria                                                                |
| 17:50  |         | End of sessions                                                                                 |                                                                                                |
Oral Sessions

Friday, 2 June, 08:30 – 10:10   Hard Materials – Modeling & Simulation

Chair: Peters Carsten, Hilti Corporation, Liechtenstein
Danninger Herbert, Vienna University of Technology, Austria

Location: Walter Schwarzkopf Hall, WSH

08:30   HM 30   A numerical representation of the industrial production of tungsten powders
Estupinan Donoso A.A.*, Hippe F.**, Peters B.***, Wilmes A.A.R.**
*CERATIZIT Luxembourg S.à r.l., University of Luxembourg, Luxembourg
**CERATIZIT Luxembourg S.à r.l., Luxembourg
***University of Luxembourg, Luxembourg

08:50   HM 31   Development of a thermodynamic database for WC based cemented carbides
with Ni3Al+Co as composite binder phase
*Shijiazhuang Tiedao University, China
**Central South University, China
***Hunan University of Science and Technology, China
****State Key Laboratory of Cemented Carbide, Zhuzhou, China

09:10   HM 32   Theory of ultra-thin film formation in Ti and Ta doped cemented carbides
Johansson S.*, Wahnström G.*
*Chalmers University of Technology, Sweden

09:30   HM 33   Computer simulation on grain growth during sintering for cemented carbides,
cermets and ceramics
Matsubara H.*
*Tohoku University, Japan

09:50   HM 34   ICME guided modeling of surface gradient formation in cemented carbides
Walbrühl M.*, John Å.*, Blomqvist A.**, Larsson H.*
*KTH Royal Institute of Technology, Sweden
**Sandvik Coromant R&D, Sweden

10:10 – 10:40   Break
Oral Sessions

Friday, 2 June, 10:40 – 12:10  Refractory Metals – Modeling & Simulation

Chair:  Smid Ivi, Pennsylvania State University, USA
        Schäfer Jonathan, Ceratizit Austria, Austria
Location: Walter Schwarzkopf Hall, WSH

10:40  RM 35  Numerical simulation of the entire production route of refractory metals from powder to a sintered metal part
        Grohs C.*, Reinfried N.*, Plankensteiner A.*
        *Plansee SE, Austria

11:10  RM 36  Quantifying the effect of C, O and Fe co-segregation in Mo with ab-initio simulations
        Scheiber D.*, Pippan R.**, Puschnig R.***, Romaner L.*
        *Materials Center Leoben Forschung GmbH, Austria
        **Erich Schmid Institut of Materials Science, Austria
        ***University of Graz, Austria

11:30  RM 37  CFDEM modelling of particle heating and acceleration in cold spraying
        *Plansee SE, Austria
        **Johannes Kepler University, Linz, Austria

11:50  RM 79  Understanding the W-Ni system for a tungsten heavy alloy: a phase diagram approach
        Cury R.*
        *Plansee Tungsten Alloys, France

12:10  Farewell Address
        Kestler H.*
        *Secretary of the 19th Plansee Seminar, Plansee SE, Austria

12:50  End of Seminar
Poster Evening

Tuesday, 30 May, 18:00 – 22:00

Note: All posters are on display during the whole seminar.

Poster Session Refractory Metals – Additive Manufacturing

Location: Poster Hall I

RM 39  Effect of process parameters on the selective laser melting (SLM) of tungsten
Enneti R.*, Morgan R.*, Atre S.**
*Global Tungsten & Powders Corp., USA
**University of Louisville, USA

RM 40  A novel printable stainless tool steel platform
Lemke H.*, Tufflie C.*
*NanoSteel, USA

RM 41  Investigation of the selective laser melting process with tungsten metal powder
Sidambe A.*, Fox P.*
*University of Liverpool, United Kingdom

RM 42  Multi-material manufacturing and large structures made by additive manufacturing using a blown powder process
Neubauer E.*, Valy L.*, Grech D.*, Kitzmantel M.*
*RHP-Technology GmbH, Austria

RM 44  Fused filament fabrication for the production of metal and/or ceramic parts and feedstocks therefore
*University of Leoben, Austria
**OBE Ohnmacht & Baumgärtner GmbH & Co. KG, Germany
***HAGE Sondermaschinenbau GmbH & Co KG, Austria
****Fraunhofer Institute for Ceramic Technologies and Systems IKTS, Germany

Poster Session Refractory Metals – Applications

Location: Poster Hall I

RM 45  Effect of long shelf-time on transformations in Zr-Nb-Pt-Pd biomedical alloys
Gasik M.*, Hanawa T.**, Nomura N.***
*Aalto University School of Chemical Technology, Finland
**Tokyo Medical and Dental University, Japan
***Tohoku University, Japan

RM 46  Reclaim of high value powder metallurgy refractory components using W-Re CVD
Poquette B.*, Huot G.*, Poirel H.*, Petitjean A.*
*ACERDE, France

RM 47  Molybdenum and tungsten in sapphire crystal growth industry
Mark M.*, Traxler H.*, Schiftner R.*, Kleinpaß B.*, Knabl W.*
*Plansee SE, Austria
Poster Evening

RM 49  Molybdenum-copper-composites for the advanced thermal management of modern electronics
Seiss M.*, Mrotzek T.*, Dreer N.*, Knippscheer S.*, Knabl W.*
*Plansee SE, Austria

RM 82  Refractory metals for particle producing targets at CERN
*CERN, Switzerland

RM 84  Tungsten-based composites as a die material in high-pressure die-casting
*Österreichisches Gießerei-Institut, Austria
**BMW AG Landshut, Germany

Poster Session Refractory Metals – Characterization

Location: Poster Hall II

RM 50  Characteristics of W nanoparticles prepared with different hydrogen reduction and ball milling conditions of WO3 powders
Kwon N.-Y.*, Jeong Y.-K.**, Oh S.-T.*
*Seoul National University of Science and Technology, South Korea
**Pusan National University, South Korea

RM 51  Experimental evidences of Nowotny phase incongruent melting
Gnesin B.*, Gnesin I.**
*Russian Academy of Science, Russia
**ISSP RAS, Russia

RM 52  Analysis of thorium and uranium in tungsten ore concentrates
*GTP, USA

RM 54  Non-destructive measurement of the tungsten content in the binder phase of tungsten heavy alloys
*Technical University of Vienna, Austria
**Plansee Composite Materials GmbH, Germany

RM 55  High-temperature phase equilibria in the Mo–Al and Mo–Al–Ti systems
Kriegel M.J.*, Walnsch A.*, Fabrichnaya O.*, Freudenberg J.*, Leineweber A.*
*Technical University Bergakademie Freiberg, Germany

RM 80  Microstructures and mechanical properties of Mo-Re alloys
*Northwest Institute for Non-ferrous Metal Research, China
Poster Evening

Poster Session Refractory Metals – Materials

Location: Poster Hall I

RM 56  Molybdenum lanthanum alloy thermal stability study
Liu R.*, Zhang T.*
*Jinduicheng Molybdenum Co., Ltd., China

RM 57  Effect of texture uniformity of Nb rods on performance of Nb3Sn superconductor
Smathers D.*, Bhattacharyya A.*
*H.C. Starck, Inc., USA

RM 58  Microstructure and mechanical property of Nb-Ti-Al alloy extruded rod
*Northwest Institute for Non-ferrous Metal Research, China

RM 59  Effect of Zr and Hf additions on microstructure and mechanical properties of multicomponent Nb-Ti-Al-Cr alloy
*Northwest Institute for Non-ferrous Metal Research, China

RM 60  High temperature mechanical properties of composites based on the niobium-silicon system
*Institute of Solid State Physics, RAS, Russia
**All-Russian Scientific Research Institute of Aviation Materials, Russia

RM 61  Preparation of W-W2B composites from W-BN powders and W-B-N barrier properties for copper metallization
Ivanov E.*, del-Rio E.*
*Tosoh SMD Inc., USA

RM 62  Ductilisation of tungsten (W) through cold-rolling: correlation of microstructure and mechanical properties in UFG-W sheets
Bonk S.*, Reiser J.*, Hoffmann J.*, Hoffmann A.*
*Karlsruhe Institute of Technology, Germany
**Plansee SE, Austria

RM 63  Change of brittle to ductile transition temperature (BDTT) in highly cold deformed tungsten (W) through cold rolling
Bonnekoh C.*, Reiser J.*, Hoffmann J.*, Bonk S.*, Hoffmann A.*
*Karlsruhe Institute of Technology, Germany
**Plansee SE, Austria

RM 64  Tensile strength, ductility and anisotropy of commercially pure tungsten rolled plates from six suppliers
*Consorcio ESS Bilbao, Spain
**CEIT-IK4 and University of Navarra, Spain
Poster Evening

RM 65  Application and mechanical properties of tungsten ribbon
*Nippon Tungsten Co., Ltd., Japan
**University of Tokyo, Japan

RM 66  Effect of molybdenum powder micro-morphology on properties of molybdenum sheet
An G.*, Cao W.*, Sun J.*
*Jinduicheng Molybdenum Co., Ltd., China
**Xi’an Jiaotong University, China

RM 67  Preparation and analysis on fracture behavior of molybdenum boat doped with La
Han Q.*
*Jinduicheng Molybdenum Co., Ltd., China

RM 68  The microstructure and mechanical properties of Mo-La2O3 alloys prepared by hot pressing sintering
*X’ian University of Technology, China
***Northwest Institute for Non-ferrous Metal Research, China
**Jinduicheng Molybdenum Co., Ltd., China

RM 69  Replacement of Ta elements with Ta-W elements in Nb3Sn superconductors
Smathers D.*, Aimone P.*
*H.C. Starck, Inc., USA

RM 70  High-temperature compressive strength and room-temperature fracture toughness of TiC and/or ZrC-added Mo-Si-B alloys
Nakayama S.*, Yoshimi K.*
*Tohoku University, Japan

Poster Session Refractory Metals – Processing

Location: Poster Hall II

RM 70  Rotary friction welding of molybdenum components
*Graz University of Technology, Austria
**Plansee SE, Austria
***Klaus Raiser GmbH & Co. KG, Germany

RM 71  Sintering behavior of spherical mono-sized tungsten powder
Schade P.*
*HTM Consulting, Germany

RM 72  Fabrication of metallic porous structure by powder injection molding process and space holder technique
Oho H.*, Park S.J.*
*Pohang University of Science and Technology, South Korea

RM 73  Tungsten fibre-reinforced tungsten composites
*Forschungszentrum Jülich GmbH, Germany
**Max-Planck-Institut für Plasmaphysik, Germany
***RWTH Aachen University, Germany
RM 74 Processing of tungsten fiber-reinforced tungsten by hot isostatic pressing
"Forschungszentrum Jülich GmbH, Germany
**Max-Planck-Institut für Plasmaphysik, Germany

RM 75 Rapid material development and processing of complex near-net-shaped parts by PIM
"Karlsruhe Institute of Technology, Germany

Poster Session Refractory Metals – Simulation

Location: Poster Hall I

RM 76 Numerical and experimental analysis of parametric possibilities resistance heating molybdenum thin sheet
Donic T.*, Frivaldský M.*, Martikán M.*
"University of Žilina, Slovakia

RM 77 Determination of the input parameters of the drawbead model for numerical analysis of deep drawing of molybdenum sheet
Baštovanský R.*, Martikán M.*, Brumercík F.*
"University of Žilina, Slovakia

RM 78 Numerical analysis of the transient electro-thermal behavior of refractory metal based evaporation boats
Valentini B.*, Gerzoskovitz S.*
"Plansee SE, Austria

RM 86 Analysis of plasma characteristics in a DC sputtering magnetron – Part I: Experimental work – Correlating molybdenum target properties and process parameters
Raggl S.*, Winkler J.*", Strauss G.*", Plankensteiner A.*", Feist C.*", Linke C.*", Eidenberger-Schober M.*", Scheier P.*
"University of Innsbruck, Austria
**Plansee SE, Austria
***PhysTech Coating Technology GmbH, Austria
****CENUMERICS, Austria

RM 87 Analysis of plasma characteristics in a DC sputtering magnetron – Part II: Numerical modelling – Development of a self-consistent hybrid plasma transport model
Feist C.*, Plankensteiner A.*", Winkler J.*", Raggl S.*", Linke C.*
*CENUMERICS, Austria
**Plansee SE, Austria
***University of Innsbruck, Austria
Poster Evening

Poster Session Hard Materials – Applications

Location: Poster Hall I

HM 54 Irradiation of tungsten carbide hardmetals for fusion applications
Hinks J.A.****, Donnelly S.E.***
*Imperial College London, United Kingdom
**Tokamak Energy Ltd., United Kingdom
***Huddersfield University, United Kingdom
****Huddersfield University, United Kingdom

HM 55 Investigation on corrosion and tribo-corrosion behaviour of hardmetal grades in simulated petrochemical environments
De Gaudenzi G.P.*, Tedeschi S.*, Bozzini B.**
*F.I.L.M.S. S.p.A., Italy
**Università del Salento, Italy

HM 56 Influence of ruthenium ion implantation on the machining performance of WC straight grade inserts
Mkhaliphi T.*, Sacks N.*
*University of the Witwatersrand, South Africa

HM 57 Study of tool wear and chemical interaction during machining of Ti6Al4V
Kaplan B.*, Odelros S.*, Kritikos M.*, Bejani R.*, Norgren S.**
*Sandvik Coromant, Sweden
**Sandvik Coromant, Uppsala University, Sweden

HM 59 The use of NbC20Ni hard materials for hot rolling applications
Rodrigues D.*, Cannizza E.**
*BRATS Sintered Filters and Metallic Powders, Brazil
**EHT – Engineering Consulting, Brazil

HM 60 Research on end milling of AISI 304 stainless steel using TiCN based cermet mills
Nie H.*, Guo X.*, Lai J.*, Yu Y.*
*Xiamen Tungsten Co., Ltd., China

HM 61 High efficient milling of high-strength alloys (HSA) using new PVD-coatings
Frank H.*, Barthelmä F.*, Schliffner M.*
*GFE - society of production engineering Schmalkalden, Germany

HM 62 Cemented carbides for cold forging tools
Kniely C.*, Engel U.*, Merklein M.*, Andreas K.*
*Friedrich-Alexander-Universität Erlangen-Nürnberg, Germany

HM 63 Microstructure and wear behavior of improved NbC cermets for (BS-1452) grey cast iron machining
*University of the Witwatersrand, South Africa
**CSIR National Laser Centre, Pretoria, South Africa
***Federal Institute for Materials Research and Testing, Germany
****Centre for High Resolution Transmission Electron Microscopy, South Africa

HM 64 Effect of milling parameters on the temperature in the direct carburization of tungsten trioxide by mechanical alloying
Stanciu V.I.*, Vitry V.*, Delaunois F.*
*University of Mons, Belgium
Poster Session Hard Materials – Characterization

Location: Poster Hall II

HM 65  In situ micro-mechanical testing of WC/Co hardmetals
*National Physical Laboratory, United Kingdom

HM 66  Influence of surface damage and residual stress on strength of WC-Co hard metals under biaxial loading conditions
*University of Leoben, Austria
**Materials Center Leoben Forschung GmbH, Austria
***CERATIZIT Austria GmbH, Austria

HM 67  Effects of trace amount of titanium additions on microstructures and mechanical properties of medium-grained WC-8%Co cemented carbides
Hong H.*, Cheng X.*, Zhang W.*
*State Key Laboratory of Cemented Carbide, China

HM 69  Influence of two steps sintering method on the microstructure and mechanical properties of ultrafine cemented carbide
Liu B.*, Mu Z.*, Zou N.*, Tang S.*
*State Key Laboratory of Cemented Carbide, China
**Zhuzhou Cemented Carbide Group Co., Ltd., China

HM 70  Micromechanical testing of CVD diamond coated WC-Co hard metals
*Materials Center Leoben Forschung GmbH, Austria
**CERATIZIT Austria GmbH, Austria
***University of Leoben, Austria

HM 71  Study on various properties in the Ti(CN)-based alloys
*Korloy Inc., South Korea

HM 72  Effect of WC grain size and Cr addition on the corrosion behavior of WC-Co cemented carbides
Xia Y.*, Wei X.*, Yu H.*
*Zhuzhou Cemented Carbide Group Co., Ltd., China

HM 73  Scale effect in mechanical characterization of WC-Co composites
*Universitat Politècnica de Catalunya, Spain
**Italian National Agency for New Technologies, Energy and Sustainable Economic Development, Italy
***Sandvik Hyperion, United Kingdom

HM 74  Indentation-induced deformation of ultracoarse grain cemented carbides
Liu X.*, Zhang J.*, Wang H.*, Song X.*
*Beijing University of Technology, China

HM 75  Fracture toughness evaluation of high pressure high temperature sintered WC-10 wt% Co hardmetal
Mashhadikarimi M.*, Umbelino Gomes U.*, Picanço Oliveira M.*, Da Silva Guimarães R.*, Filgueira M.*
*Federal University of Rio Grande do Norte, Brazil
**Northern Fluminense State University, Brazil
HM 76  Repeatability of the tests performed on hard metal micro-samples
*Ceit-IK4 and University of Navarra, Spain
**Universitat Politècnica de Catalunya, Spain
***National Physical Laboratory, United Kingdom
****Ceit-IK4, Spain

HM 77  Characterization of new WC-stainless steel composites
*University of Aveiro, Portugal
**DURIT - Metalurgia Portuguesa do Tungsténio Lda, Portugal

HM 78  Comparison of the damage induced by thermal shock in hardmetals and cermets used in hot rolling applications
Sánchez-Moreno J.M.*, Lopez Ezquerra B.*
*Ceit-IK4, Spain

HM 142  Experimental measurement and thermodynamic evaluation of the miscibility gaps in MC carbides for the C–Co–Hf–Ta–Ti–W system
*State Key Laboratory of Powder Metallurgy, Central South University, China
**Central South University, China
***Hunan University of Science and Technology, China

Poster Session Hard Materials – Coating

Location:  Poster Hall I

HM 79  Influence of Ti1-xAlxN (x=0.48, 0.58 and 0.66) insertion layers on microstructure, mechanical and thermal properties of CrAlN coating
*Zhuzhou Cemented Carbide Cutting Tools Co., Ltd., China
**Central South University, China

HM 80  In-plane and cross-plane thermal conductivity of micro- and nanocrystalline diamond films on a substrate
Becker M.*, Buck V.*
*University of Duisburg-Essen, Germany

HM 81  Hard nitrides based on the refractory Mo and W
*CDL-AOS at Technical University of Vienna, Austria
**Oerlikon Surface Solutions AG, Liechtenstein
***Plansee Composite Materials GmbH, Germany
****Technical University of Vienna, Austria
*****University of Leoben, Austria

HM 82  Study of WC- and Cr3C2-containing hardmetal compositions for thermal spray coatings
*Fraunhofer Institute for Ceramic Technologies and Systems IKTS, Germany
**University of Modena and Reggio Emilia, Italy
### HM 83
Arc evaporated W-alloyed Ti-Al-N coatings for improved thermal stability, mechanical, and tribological properties


*CDL-AOS at Technical University of Vienna, Austria  
**Oerlikon Surface Solutions AG, Liechtenstein 
***Plansee Composite Materials GmbH, Germany 
****Technical University of Vienna, Austria

### HM 85
Wear protective coatings for cutting tools applications produced by S3p™

*Oerlikon Surface Solutions AG, Liechtenstein

### HM 86
Coatings 4.0 - High rate HiPIMS coating equipment for premium cutting tools

Schiffers C.*, Leyendecker T.*, Lemmer O.*, Köller W.*  
*CemeCon AG, Germany

### HM 87
On the phase evolution of Al-Cr-based intermetallics and oxides formed by cathodic arc evaporation

Dalbauer V.*, Ramm J.**, Kolozsvári S.***, Koller C.M.*, Mayrhofer P.H.****

*CDL-AOS at Technical University of Vienna, Austria 
**Oerlikon Surface Solutions AG, Liechtenstein 
***Plansee Composite Materials GmbH, Germany 
****Technical University of Vienna, Austria

### HM 88
Cross-sectional characterization techniques as the basis for knowledge-based design of graded CVD TiN-TiB<sub>2</sub> coatings


*University of Leoben, Austria  
**CERATIZIT Austria GmbH, Austria

### HM 89
Straightforward measurement of thermal conductivity of hard coatings with the TDTR method


*Fraunhofer Institute for Physical Measurement Techniques IPM, Germany  
**University of Leoben, Austria  
***CERATIZIT Austria GmbH, Austria

### HM 90
The effects of sputter deposition parameters on the microstructure and surface morphology of Mo-Alloy thin films

Jalili H.*, Zhang Q.*, Rozak G.*, Dary F.*  
*H.C. Starck, Inc., USA

### HM 91
Chemical composition and properties of MoAl thin films deposited by sputtering from MoAl compound targets


*University of Leoben, Austria  
**Plansee SE, Austria

### HM 92
Influence of cutting speed and workpiece material on the wear mechanisms of CVD TiCN/α-Al2O3 coated cutting inserts during turning


*University of Leoben, Austria  
**CERATIZIT Austria GmbH, Austria

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**Poster Evening**
HM 93  A study of the effect of CO2 content on the orientation of Al2O3 in CVD process
Kubo H.*, Kodama Y.*, Kawaguchi M.*, Tanibuchi T.*
*Kyocera Corporation, Japan

HM 94  Arc evaporated Ti-Al-N/Cr-Al-N multilayer coating systems for cutting applications
*CERATIZIT Austria GmbH, Austria
**CERATIZIT Luxembourg S.à r.l., Luxembourg
***University of Leoben, Austria

HM 95  Oxidation resistant hardmetal coatings by Si-impregnation
*Imperial College London, United Kingdom
**Tokamak Energy Ltd., United Kingdom

HM 96  Influence of the Ta content on microstructure, properties and thermal stability of arc evaporated Ti1-x-yAlxTayN hard coatings
*University of Leoben, Austria
**CERATIZIT Austria GmbH, Austria

HM 97  Advanced CVD equipment
Strakov H.*, Auger M.*, Papageorgiou V.*, Vogiatzis S.*
*IHI Ionbond AG, Switzerland

HM 98  Innovations and applications on hard coating systems – Study of the influence of different deposition techniques on the structure of Tantalum
Nguyen T.L.*, Estoppey S.**
*Akrom AG, Switzerland
**Estoppey-Reber SA, Switzerland

Poster Session Hard Materials – Materials

Location: Poster Hall I

HM 100  Preparation and properties of (W,Mo)C powders and (W,Mo)C-Co cemented carbides
Shi K.-h.*, Schwarz V.*, Lengauer W.*
*Technical University of Vienna, Austria

HM 102  The potential of niobium carbide (NbC) as cutting tools and for wear protection
Woydt M.*, Mohrbacher H.**, Vleugels J.***, Huang S.***
*Federal Institute for Materials Research and Testing, Germany
**Niobelcon BVNA, Belgium
***Katholieke Universiteit Leuven, Belgium

HM 103  Phenomena of self-assembling interfacial WC layer formation on diamond crystals during the sintering with catalyst – new horizon for diamond tools ability
Levashov E.*, Sidorenko D.*, Loginov P.*
*National University of Science and Technology, Russia

HM 105  Cutting tools made from niobium carbide
Uhlmann E.*, Kropidloowski K.*, Woydt M.**, Sammler F.*
*Technical University of Berlin, Germany
**Federal Institute for Materials Research and Testing, Germany
HM 106  Sintering features of WC-316L composite
Santos A.*, Gomes U.*
*Universidade Federal do Rio Grande do Norte, Brazil

HM 107  Effect of initial WC grain sizes on the microstructure and properties of WC-10Ni cemented carbides
Zan X.*, Shi K.*, Liao J.*, Min Z.*
*Zigong Cemented Carbide Corp., Ltd., China

HM 108  Preparation and microstructure of nanocrystalline powders of nonstoichiometric tantalum carbide TaCy
Kurlov A.*, Gusev A.*
*Institute of Solid State Chemistry, Russian Academy of Sciences, Russia

HM 109  Effect of carbon content on the microstructure and mechanical properties of NbC-Ni based cermets
Huang S.*, Vleugels J.*, Mohrbacher H.*, Woydt M.**
*Katholieke Universiteit Leuven, Belgium
**Federal Institute for Materials Research and Testing, Germany

HM 111  Processing and characterization of PM diamond beads
*Northern Fluminense State University, Brazil

HM 112  Microstructure and properties of γ/γ’-strengthened composite binder in WC–Co–Ni–Al cemented carbide
*State Key Laboratory of Cemented Carbide, China
**State Key Laboratory of Powder Metallurgy, China

HM 113  Production of cBN/WC bilayer inserts by HPHT using an innovative Nb based binder
*Northern Fluminense State University, Brazil
**Federal University of Rio Grande do Norte, Brazil

HM 114  A comparative study of spark plasma sintered TiCx-Ni3Ti/Ni cermet
Liu B.*, Huang S.*, Van Humbeeck J.*, Vleugels J.*
*Katholieke Universiteit Leuven, Belgium

HM 115  Analytical microstructure characterization of advanced alloys and steels at atomic resolution
Albu M.*, Haberfehlner G.*, Kothleitner G.*, Hofer F.**
*Graz Centre of Electron Microscopy, Austria
**Graz University of Technology, Austria

HM 116  Effects of Cr on the properties of WCoB ternary boride
Zhang T.*, Yin H.*, Qu X.*, Zheng Q.**
*University of Science and Technology Beijing, China
**Kennametal Inc., USA

HM 118  Cobalt-inhibitors mixtures for cemented carbides
Stanciu V.I.*, Vitry V.*, Delaunois F.*
*University of Mons, Belgium
Poster Evening

Poster Session Hard Materials – Modeling & Simulation

Location: Poster Hall I

**HM 119 Solubility of Cr in cubic carbides**
*Sandvik Coromant, Sweden
**KTH Royal Institute of Technology, Sweden

**HM 120 EBSD based FEM simulation of residual stresses in a WC 6wt.-% Co hardmetal**
Kayser W.*, Bezold A.*, Broeckmann C.*
*RWTH Aachen University, Germany

**HM 121 2D simulation of gradient zone formation in cemented carbides**
Salmasi A.*, Larsson H.*, Blomqvist A.**
*KTH Royal Institute of Technology, Sweden
**Sandvik Coromant, KTH Royal Institute of Technology, Sweden

**HM 122 Alternative binder phases in cemented carbides**
Gren M.*, Wahnström G.*
*Chalmers University of Technology, Sweden

**HM 123 Three-dimensional modeling of the microcracks in a heterogeneous hot work tool steel**
*University of São Paulo, Brazil

**HM 124 Modelling heat transfer in a W+C powder bed in a pusher furnace**
Witting P.*, Jewett T.**
*Harper International, USA
**Global Tungsten & Powders Corp., USA

**HM 125 Real microstructure-based simulation of thermal residual stresses in cemented carbides**
*Central South University, China

**HM 126 An advanced multi-scale and multi-physics simulation framework for powder metallurgy**
Peters B.*, Estupinan A.*, Useldinger R.**, Hippe F.**
*Université du Luxembourg, Luxembourg
**CERATIZIT Luxembourg S.à.r.l., Luxembourg

**HM 141 Thermal residual stresses in WC-Co using realistic 3D synthetic microstructures**
Öhman M.*, Ekhl M.*, Larsson F.*, Wahnström G.*
*Chalmers University of Technology, Sweden
Poster Evening

Poster Session Hard Materials – Processes

Location: Poster Hall II

HM 127 Optimized way to introduce a growth inhibitor in cemented carbides
Stanciu V.I.*, Vitry V.*, Delaunois F.*
*University of Mons, Belgium

HM 129 Sputter-coating of WC powders: An innovative process to attain high performance
*University of Aveiro, Portugal
**Fritz Haber Institute of the Max Planck Society, Germany
***University of Coimbra, Portugal

HM 130 Cobalt oxide as a raw material for the production of WC-Co cemented carbides and its advantages for the pressing process
Pasquazzi A.*, Schubert W.D.**, Weißenbacher R.*, Schachinger P.*
*BOEHLERIT GmbH & Co KG, Austria
**Vienna University of Technology, Austria

HM 131 Research on production technology of cemented carbide rods with two spiral coolant holes
Meng X.W.*, Wu Z.W.*, Chu Y.D.*
*Zhuzhou Cemented Carbide Group Co., Ltd., China
**Zhuzhou Cemented Carbide Tools Co., Ltd., China

HM 132 Transition of W2C to WC during carburization of tungsten metal powder
*Wolfram Bergbau und Hütten AG, Austria
**Chalmers University of Technology, Sweden
***Vienna University of Technology, Austria

HM 134 High strength bulk steels for high temperature structural applications produced by mechanical alloying in combination with equal channel angular extrusion
Kotan H.*, Darling K.A.**
*Konya Necmettin Erbakan University, Turkey
**U.S. Army Research Laboratory, USA

HM 135 Colloid processing of metal bonded niobium carbide
Steinborn G.*, Woydt M.*, Wäsche R.*
*Federal Institute for Materials Research and Testing, Germany

HM 137 Production of Fe-36%wtNi alloys with Nb additions by mechanical alloying
*Northern Fluminense State University, Brazil

HM 138 Solid state sintered nanoscaled hardmetals and their properties
Pötschke J.*, Säuberlich T.*
*Fraunhofer Institute for Ceramic Technologies and Systems IKTS, Germany
**H.C. Starck Tungsten GmbH, Germany

HM 139 Direct carbothermic synthesis of tungsten carbide from tungsten minerals
Polini R.*, Marcucci A.*, Marcheselli G.*
*Università di Roma, Italy
**F.I.L.M.S. SpA, Italy

HM 140 Chromium carbide base cermets obtained by mechanically activated synthesis and spark plasma sintering
*Tallinn University of Technology, Estonia
Poster Session Recycling and Tungsten Chemistry

RC 6  Insights regarding the reaction rate of Co during the leaching of a hard metal substrate in hydrochloric media
*University of Leoben, Austria
**CERATIZIT Austria GmbH, Austria

RC 7  The International Journal of Refractory Metals and Hard Materials – A guidepost in the field of material technology
*Technical University Darmstadt, Germany
**University of Utah, USA
***National Physical Laboratory, United Kingdom
****Reutte, Austria
*****Beijing University of Technology, China

RC 8  Milling characteristics of various zinc reclaim and virgin WC-Co powders
*Tikomet Oy, Finland
**Global Tungsten & Powders Corp., USA

RC 9  Several promising purifying technologies for refractory metals
*Northwest Institute for Non-ferrous Metal Research, China
**Northwestern Polytechnical University, China
***Chinese Institute of Atomic Energy, China

RC 10  Ecologically clean fluoride conversion – New technology of tungsten production instead powder metallurgy
Korolev Y.*, Levashov E.**
*Scientific Techn. Association of Powder Metallurgy, Russia
**National University of Science and Technology, Russia

RC 11  Phase formation in Co(Ru)-Zn diffusion couples
*University of Leoben, Austria
**CERATIZIT Austria GmbH, Austria

RC 12  A study of the impact of reduction conditions on molybdenum morphology
Boltschek J.*, Luidold S.*, O’Sullivan M.**
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