SFB 920

Multifunktionale Filter für die Metallschmelzefiltration – ein Beitrag zu Zero Defect Materials

NEWSLETTER 12 (1/2017)

DFG Deutsche Forschungsgemeinschaft

TECHNISCHE UNIVERSITÄT BERGAKADEMIE FREIBERG

DEAR READERS,

Investigating and developing high-performance materials and technologies requires to capture the entire process chain, leading from materials and their properties to resulting applications. Moreover, relations and exchanges between researchers from diverse disciplines and countries is what drives materials research.

In both respects, the Collaborative Research Center CRC 920 is standing out: Research activities reflect the entire innovative process chain, encompassing analyses, materials design, and the advanced understanding of fundamental mechanisms of active and reactive filter materials. The CRC's success builds upon an intensive collaboration between several disciplines and international research partners from Europe, Asia, and America.

Details on related activities and results are available in our latest issue of this newsletter. Further information is provided at http://sfb920.tu-freiberg.de. We hope you'll enjoy the newsletter.

Yours sincerely,

Prof. Dr.-Ing. habil. Christos G. Aneziris
CRC 920 Coordinator

Prof. Dr.-Ing. habil. Horst Biermann
CRC 920 Vice Coordinator

INHALT

REFRACTORY EXPERTS MEET AT TU BERGAKADEMIE FREIBERG

About 130 national and international representatives from industry, research, and professional associations attended the 7th Refractory Experts' Forum to learn more about current developments in refractory materials and high-temperature applications. On this occasion, the Theodor Haase Prize has been awarded for outstanding master and diploma theses on refractories and high-temperature applications. This year's awardee is Dipl.-Ing. Tony Wetzig (TU Bergakademie Freiberg).

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The 7th Refractory Experts' Forum, which took place in December 2016 at TU Bergakademie Freiberg, shed light on the investigation and development of refractories and refractory construction materials for extreme applications in Asian, European and North American markets. Key notes were provided by experts from Germany, Iran, Japan, France and Canada. A poster session from the Collaborative Research Center "Multi-functional filters for metal melt filtration - A Contribution towards Zero Defect Materials" presented results of current research activities and novel research approaches in the field of refractory materials.

Dr. A. Nourbakhsh, leading academic from the **Islamic Azad University, Isfahan, Iran**, gave a talk on nano additives for the development of refractory materials. **Christopher Parr, Vice President for Production Development from Kerneos, France**, introduced future developments of unformed refractory masses as a way to respond to increasing requirements of high-temperature environments. **Prof. In-Ho Jung from the McGill University Montreal, Canada**, presented innovative approaches for leveraging corrosion resistance of refractory linings for RH deaerators. Dipl.-Ing. Anne Schmidt (Institute of Ceramics, Glass and Construction Materials) dedicated her presentation to the application of carbon-bonded refractories for metal melt filtration. Prof. Makoto Kawakami from Akita University, Japan, provided an overview on specific construction materials and their properties used for extreme applications in seismic areas in the Far East.

The Freiberg Refractory Experts' Forum aims at enhancing the dialogue between academics and the industry, to ensure a continuous advancement of refractory materials. In particular, the forum offers researchers to anticipate current requirements of the industry, such as customer demands or political constraints for a sustainable economy.

To promote young scientists, every year the MORE e.V. Freiberg endows the Theodor Haase Award for excellent master and diploma theses on refractories and high-temperature applications. The award is regularly assigned on the occasion of the Refractory Experts' Forum. This year, Dipl.-Ing. Tony Wetzig received the prize for his thesis on computer-assisted gel foundry for generating carbon-bonded ceramic structures for steel melt filtration. "Pursuing novel, non-traditional approaches, this thesis makes a strong contribution to the development of innovative refractory materials and components used in metal melts and under high-temperature conditions," says Prof. Christos G. Aneziris, professor at the Institute of Ceramics, Glass and Construction Materials and responsible supervisor. The award is dedicated to the memory of the Freiberg academic Theodor Haase and his contributions to the education of young ceramic engineers.

Photo (from left to right): Dipl.-Ing. Tony Wetzig, awardee of the 2016 Theodor Haase Prize, and Prof. Dr. Christos G. Aneziris, coordinator of the CRC 920.

Furthermore, more than 30 representatives from the European refractory and steel industry met in May 2017 for the **Expert Committee Meeting of the Stahlinstitut VdEh**. Their aim was to learn more about current research projects, trends and potentials in the field of refractory materials. The aim of the Stahlinstitut VdEh, located in Duesseldorf, and its national and international research partners is to promote and advance steel technology. **Prof. Olena Volkova (Institute for Iron and Steel Technology) and Prof. Christos G. Aneziris (Institute of Ceramics, Glass and Construction Materials)** presented results from the CRC 920's research activities. "Our recent results clearly demonstrate that novel ceramic filter materials with functionalized surfaces permit highly efficient filtration higher than 95 % for steel melts. After having successfully tested dead-mould casting under realistic conditions, we will for the first time design novel functionalized filter components and filter systems for continuous casting of iron-containing metal melts," Prof. Christos G. Aneziris, CRC coordinator, explained.■

MORE NEWS

Several international scholars visited the CRC 920 and supported related research activities. Among them was **Assoc. Prof. Ph.D Wen Yan from Wuhan University of Science and Technology/China**. He is involved with porous ceramics and refractory materials for wear lining. **Prof. Lianghua Feng from the School of Materials and Metallurgy, University of Science and Technology Liaoning/China**, has been visiting TU Bergakademie Freiberg for one year. She worked in the field of thermal power engineering and, in particular, on the simulation of heat transfer and flow behavior during warming and cooling processes in continuous casting.

INTERNATIONAL KNOWLEDGE EXCHANGE

Vice versa, young scientists from the CRC took the opportunity for guest visits at international partner institutions. In February 2017, **Dr.-Ing. Claudia Voigt** (subproject A02) visited the **Foundry Research Institute (Instytut Odlewnictwa) in Krakow/Poland**, in order to jointly conduct experiments on materials' wetting behavior. Invited by the **Universitá Degli Studi di Trento/Italy, Dipl.-Ing. Sebastian Henschel** joined the Department for Industrial Engineering and studied the impact of TiC particles on the fracture toughness of hot work tool steel. ■

Photo (from left to right): G. Bruzda, K. Michón, Dr. A. Kudyba, Dr. R. Nowak, Dr. C. Voigt.

PRESENTING ON CELLMAT 2016

The **CELLMAT 2016** dedicated one of its sessions to the CRC 920 and the presentation of its research results towards researchers, manufacturers and customers of cellular materials from around the globe. The session was entitled "„Multifunctional carbon-bonded filters for metal melt filtration." 13 presentations and one poster demonstrated the CRC's research along the entire innovation chain, leading from the development of filter materials to the modelling of micro and macro structures as well as the filter geometry up to the reduction of inclusions in metal melts and the design of tailored, high-strength metallic components.

The CELLMAT conferences provides an international platform for researchers, manufacturers and customers of cellular materials for exchanging knowledge and experiences. The recent CELLMAT 2016 was focused on manufacturing, modification, joining, property analysis and modelling of cellular materials. The CELLMAT 2016 was organized by the German Materials Society DGM. ■

Photo: Researchers of the CRC 920, presenting at CellMAT 2016.

DISCOVERY FOR YOUNG SCIENTISTS

In December 2016, the CRC 920 contributed to the **MINTec Camp Materials Technology** by offering an event for young scientists entitled "Ceramics meet steel." The event included lectures that introduced to the world of high-tech materials, and visits of a steel plant, a ceramic manufacturer and a glass manufacturer. Moreover, students could join various experiments on steel casting, materials testing and enameling of steel. A scanning electron microscope allowed discovering the micro structure of materials.

MINTec Camps are an initiative from the national Excellence School Network MINTec targeted at students from certified schools, who are invited to conduct scientific investigations in universities and companies and, hence, to broaden and amend their school knowledge in natural sciences and engineering. Besides, students get familiar with study programs, research areas, jobs and careers in mathematics, computer science, natural science, and engineering. ■

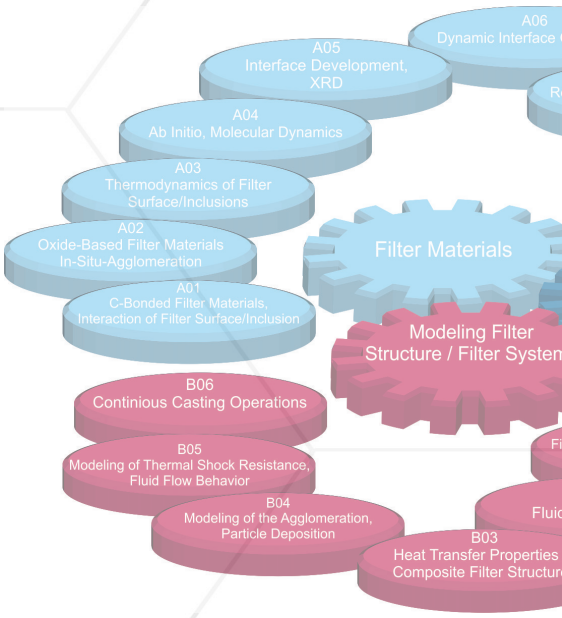
Photo (in the back, from left to right): Dipl.-Ing. Stephan Dunkel, IKGB, Dipl.-Ing. Steffen Dudczig, IKGB, (in the front, from left to right), Jasmin Heermann (MINTec-Camp coordinator), Dipl.-Ing. Kathrin Häußler (coordinator for MINTec at TU Freiberg) as well as MINTec-Camp attendees.

WORKING GROUPS' REPORT

Research teams in the CRC 920 are connected in four working groups, thus ensuring targeted activities, close collaborations between subprojects, and intensive exchanges between all researchers involved. Young scientists are taking responsibility for coordinating these working groups - a measure the CRC has taken to support young scientists already in early career stages to promote their capabilities to work independently as well as in teams and to strengthen their management skills.

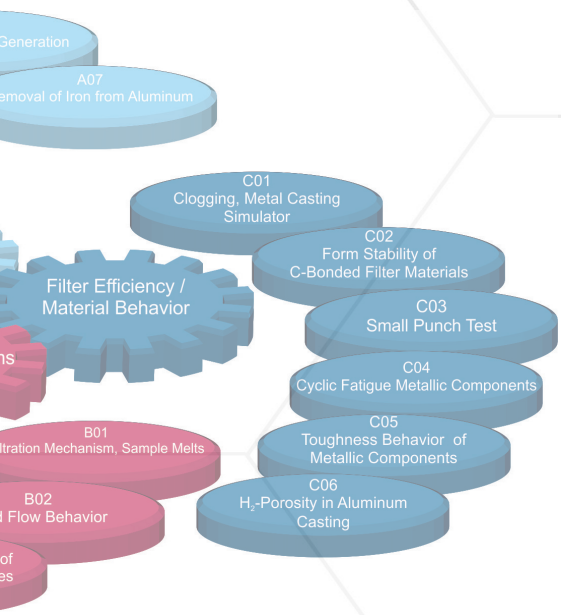
Working Group 1: "Metal melt/inclusions, active/reactive filter material, boundary surface design" (Coordination: Dr.-Ing. Claudia Voigt)

- Due to the usage of an optimized sessile drop apparatus at Foundry Research Institute in Krakow (Poland) it was possible to decrease the measuring temperature during the wetting experiment of AlSi7Mg Al_2O_3, $MgAl_2O_4$, 3 Al_2O_3 2SiO_2 und TiO_2 from 950 °C to 730 °C. Thus it is possible to measure the wetting properties at comparable temperatures as the filtration experiments (A02),
- Optimizations of the preparation of metastable Al_2O_3 filter coatings with different preparation routines (A05, A01, A02),
- Development of a thermodynamic description of the Ti-Al-O system and experimental investigations of the MgO-TiO_2 and MgO-TiO_2-Al_2O_3 systems as basis for the development of a corresponding thermodynamic database (A03),
- The analysis of a sample tested in the steel casting simulator using transmission electron microscopy revealed the presence of an amorphous layer consisting of Fe, O and Al (Si) with 50 nm thickness, containing small amounts of a crystalline phase, which is assumed to influence the nucleation of secondary corundum during the steel filtration (A06),
- SPS experiments with ceramic substrates containing different amounts of carbon in contact with different steel melt compositions have shown that higher total carbon contents lead to increased gas phase formation (CO), which can be interpreted as an indirect proof for the assumed dissolution and reprecipitation mechanism as the basis for the formation of secondary corundum (A06),
- Production of large-size, cylindrical Al_2O_3-C filter components (Ø 200 mm and 200 mm in height) for the filtration of liquid steel in the continuous casting tundish by means of centrifugation, dip coating and spray coating. Successful performance test of these filters by impingement with molten steel in the steel casting simulator (T01),
- Dipping tests with compact filter material for the determination of the reactivity of spodumene in contact with aluminum melt showed reactions from 700 °C and normal pressure. Furthermore, first filtration test with filters with spodumene coating were conducted (C06, A02),
- Determination of the influence of different parameters (for example the alloying elements Cr and Mn, different holding times and different cooling rates) on the formation of iron-containing, intermetallic precipitates in AlSi-alloys with Fe-impurity (A07, S03),
- Analysis of the crystal structures of low temperature phases which are formed from the η-Al-Fe high temperature-phase at low temperatures (< 350 °C) (A07, A04),
- Design of a new experimental set-up for industry-oriented casting trials in the metal casting simulator (C01, A01, C04),
- Evaluation of the filtration effect of different coated filters on the basis of remaining inclusions (size distribution and chemical composition) in the steel using an automatic scanning electron microscope (Aspex) (A01, C01, C04).



Working Group 3: "Thermomechanical properties of the filter material and structures" (Coordination: M.Sc. Henry Zielke)

- Spraying specimen manufacturing process (A01) for B3B experiments using different carbon contents and cooking regimes,
- Specimen manufacturing (A02) for CNB-experiments (C03),
- Description of the effective high-temperature behavior of computer generated foams (B05),
- Testing of Al_2O_3-C-foams with CT-Scan prior and subsequent to the tests to gain information about mechanisms of deformation within the foams (C02) and comparing with results of numerical simulations (B05),
- Bending tests of Al_2O_3-C-C with analysis of acoustical emission (C02),
- Experimental CNB-testing at different temperatures (room temperature and 800 °C) as well as different materials (Al_2O_3 and Al_2O_3-C) to evaluate the fracture toughness,
- Planning of upgrading the B3B test set-up to realize testing temperatures up to 1700 °C.



Working Group 2: "Modelling and designing of the filter geometry" (Coordination: Dipl.-Ing. Eric Werzner)

- Experimental investigation of the effect of particle size, flow velocity and filter thickness on the separation of Al_2O_3 particles from water inside filters with pore counts ranging from 10 to 30 ppi (B01),
- Measurement of the agglomerate strength with respect to shear forces in dependence of the wetting properties (B04),
- Commissioning of a Fourier transform infrared spectrometer as well as an Ulbricht sphere for determination of the extinction coefficient of ceramic foam filters for validation of the numerical model for radiative heat transfer (B03),
- determination of the influence of surface roughness and pore count on the Darcy and Forchheimer coefficients of ceramic foam filters using different model fluids (B03, A02, B02),,
- Numerical investigation of the effect of porosity and strut shape on strength, pressure drop, hydrodynamic tortuosity and filtration coefficient for artificial foam models (B05, B02),
- Simulations of the fluid flow in order to investigate the influence of foam filters inside the tundish and setup of an experiment for validation using a transparent filter with simplified geometry (T01, B06),
- In-situ reduction of data with high temporal resolution by means of temporal compression and realization of an interactive visualization tool for selective data access using a compressed index structure in Paraview (S02, B02).

Working Group 4: "Mechanical properties, metallic materials, critical inclusions" (Coordination: Dipl.-Ing. Tim Lippmann)

- Cast steel 18CrNi-Mo7-6 treated with different crucible materials, investigation of the mechanical properties (static and cyclic loading) and the microstructure (inclusions size, distribution, chemical composition),
- Crucible materials: (i) carbon-bonded alumina (AC), (ii) carbon-bonded alumina-zirconia-titanium oxide (AZT)-C) and (iii) AZT-C plus additional coating with carbo-nanotubes (AZT-C+n),
- Significant influence of crucible material on oxygen content and, therefore, on inclusion size and chemical composition,
- AC material: highest oxygen content resulting in the smallest inclusions size (globular, duplex-type MnS),
- AZT-C+n: lowest oxygen content; dendritic morphology of MnS inclusions,
- Reduced oxide nucleation sites for MnS and more pronounced growth MnS inclusions,
- AC crucible: highest number of inclusions at concurrently smallest inclusion size leading to the best mechanical properties under cyclic loading. (C01, C04, C05, S01),
- Reference tests on 42CrMo4 for finger test investigations: Influence of melting/solidification and oxidation/desoxidation on the formation of inclusions,
- Molten/solidified state with lower fatigue strength compared to the oxidized/deoxidized state caused by the three-times larger inclusion size (thin plate-like aluminum oxides),
- Static deformation and strength properties were nearly identical (C04, C05),
- Fingertest experiments on two steel variants 42CrMo4 (sulphur-poor and sulphur-rich), using different filters: (i) AC5 filter, with (ii) Al_2O_3 as even as (iii) CNT's and (iv) 96 % Al_2O_3 + 4 % C coated AC5 filter for 10s in contact with steel melt,
- Mechanical preparation of test specimens after application of hot-isostatic pressing process,
- Investigation of the influence of inclusions in an aluminium-alloy (AlSi7Mg),
- 01/2017 pretests at Hydro Aluminium (Bonn),)
- Optimization of the thickness of casting plates by foundry institute,
- Investigation of the microstructure and the porosity (A02, C04, S03).

AUTOMATIC INCLUSION ANALYSIS BY SCANNING ELECTRON MICROSCOPY

Author: Steffen Dudczig
(Subproject C01)

Subproject C01 analyzes non-metallic inclusions in steel samples before and after immersion tests of filter materials with different coatings. Employing EDX measures, size distribution, orientation, shape and local distribution of the inclusions the chemical composition of each found particle are identified.

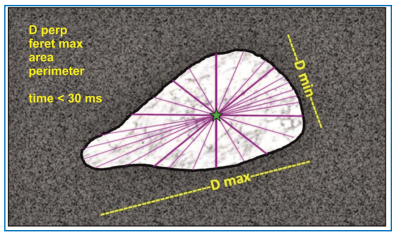


Fig. 1: Geometric analysis of an inclusion particle employing the principle of rotation axes analysis.

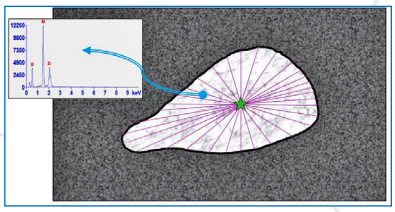


Fig. 2: EDX spectrum of an inclusion particle in the steel matrix.

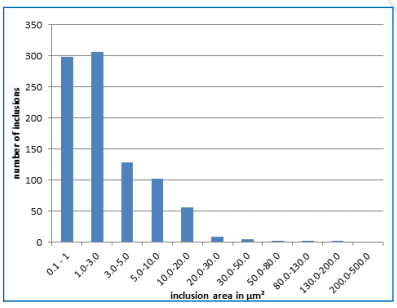


Fig. 3: Inclusion size distribution of all detectable particles in a steel sample, number of particles, classes in µm² normalized to 100 mm²

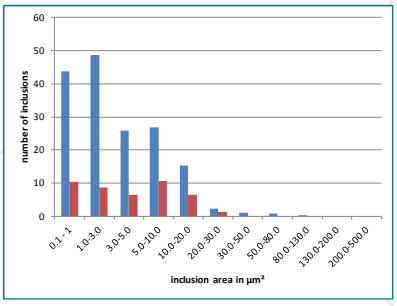


Fig. 4: Inclusion size distribution of all calcium aluminates (blue) an calcium sulfides (red) in an steel sample after trial in the steel casting simulator, number of particles, classes in µm² normalized to 100 mm²

The device PSEM Express, an automatic bench-top Scanning electron microscope (FEI) allows the automated inclusion analysis by using electron beam. By using a powerful imaging BSE-Detector high counts can be obtained. In contrast to automatic light-microscopic inclusion analysis the polished sample with a maximum size of 80 x 100 mm² is sampled in a predetermined scheme and the back scattered signal is analyzed. If the electron beam reaches an inclusion in the steel matrix a contrast difference will be detected and therefore, the particle will be automatically analyzed in terms of the geometry (Fig. 1) and the chemical composition (Fig. 2). Inclusions bigger than 0.5 microns can be analyzed. The measuring time of at least 0.2 seconds per inclusion can be named. By using a RULE-file the inclusions will be classified into classes according their size (particle size distribution) and their chemical composition like alumina, manganese sulphide, and silicates. Together with the geometrically data per each inclusion, the orientation and the coordinates on the measured area in correlation to the chemical composition allows complex statements by the ASPEX-Analysis (Fig. 3 and 4).

In immersion tests in the steel casting simulator (subproject C01) 30 kg of different types of steel are melted and partially treated by an oxidation and deoxidation process to create defined endogenous inclusions. Test temperatures between 1580 and 1650 °C were adjusted. During the immersion test with prismatic filter samples with different kinds of surface coating (subproject A01) steel samples (35 mm diameter, 10 mm thick) are taken by means a sampling system from the melt after different process steps. These different samples before and after the immersion tests together with samples prepared from the solidified steel cylinder (40 x 40x 10 mm^3) are used for ASPEX Analysis after grinding and polishing. The analysis shows noticeable indications of positive effects to the inclusion situation after immersion of filter samples.

In the work of Storti et al. [1] were demonstrated that the comparison between uncoated alumina carbon filters and MWCNTs containing coating on alumina carbon based material show a positive general reducing effect to the particle situation of the used steel melt. The MWCNTs-coated samples were more effective in removing alumina, manganese spinel and sulphide based inclusions. In case of an alumina-coating on alumina carbon based material, Schmidt et al. observed in [2] that already 10 seconds of contact time between melt and immersed filter sample caused an reduction from 50 till 70 % of the total amount of inclusions. An increased immersion time causes small increases of the amounts of alumina and silica-based inclusion in the investigated middle particles range. ■

[1] Storti, E., Dudczig, S., Hubálková, J., Gleinig, J., Weidner, A., Biermann, H.. Aneziris, C.G.: Impact of nanoengenieered surface of carbon-bonded alumina filters on steel cleanliness. Advanced Engineering Materials, accepted: 03.04.2017, DOI 10.1002/ adem.201700153.
[2] Schmidt, A., Salomon, A., Dudczig, S., Berek, H., Rafaja, D., Aneziris, C.G.: Functionalized Carbon-Bonded Filters with an Open Porous Alumina Coating: Impact of Time on Interactions and Steel Cleanliness. Advanced Engineering Materials, accepted: 03.05.2017, DOI 10.1002/ adem.201700170.

INFLUENCE OF THE SPECIMEN MANUFACTURING PROCESS ON THE STRENGTH OF AL_2O_3-C

Subproject C03 deals with the determination of temperature dependent fracture mechanical properties of ceramic filter materials. The results show a dependence of the strength on the manufacturing process, the chemical composition as well as the cooking regime of the filters.

Author: Henry Zielke
(Subproject C03)

The integrity of the filter during the metal melt filtration is a basic requirement for industrial application. Therefore, a mechanical characterization of the filter bulk material is necessary in order to predict the filter behavior. Mechanical tests are performed at which the specimen dimensions and micro-structure are similar to the real filter ones.

Two different specimen manufacturing processes are compared to each other with respect to the strength and micro-structure. The first process is based on slip casting, where the slurry is slip cast into plaster molds, dried and coked. The specimens are cut out of the resulting rectangular blocks. The second process is based on a subprocess of the filter manufacturing process. The slurry is sprayed into forms approaching final dimensions. The final step after drying and coking is a surface finishing by grinding.

The applied testing technique is the ball on three balls test (B3B), which is a modified version of the small punch test (SPT). The specimens have a diameter of D = 8 mm and a thickness of t = 0,5 mm. The specimen is loaded concentrically with a constant deflection rate by the punch until failure occurs. The test set-up enables the measurement of a load-displacement curve.

The linear-elastic thin-plate theory is applicable, in order to calculate an analytical approximation for the stress field in the B3B specimen. Previous investigations [1] showed that the first load drop correlates with the initiation of crack growth. For each specimen a fracture stress is calculated using the identified critical force.

The evaluation exhibit a large scatter of the calculated stresses, which is a well-known behavior for ceramic materials. An analysis by means of a two-parametric Weibull distribution is required. Previous investigations with different B3B set-ups and, therefore, different effective volumes support the existence of a size effect of slip cast specimens [3]. The Weibull stress σ_0 is the strength of the material for a failure probability of 63.2 %. The Weibull modulus m characterizes the scatter of the material strength. Only the volume related Weibull stress σ_0^V is allowed to be compared for different test set-ups and materials because of the size effect. Therefore, this volume related stress is calculated using a reference volume of 1 mm^3.

The results of the Weibull analysis are shown in Figure 1. For each specimen manufacturing process, 30 specimens are tested at room temperature and at high temperature of 800 °C. The results show for both processes an increase of Weibull strength with higher temperatures. Additionally, both processes result into a comparable volume related Weibull strength. Furthermore, cast specimens show a higher Weibull modulus due to a more homogeneous microstructure. The micrograph of each manufacturing process shows no apparent differences, when it is tested at different temperatures. This result is supported by the non-significant change of the Weibull modulus at different temperatures. Figure 3 and 4 show the micrograph of slip cast specimens and sprayed specimens. The microstructure of the sprayed specimens coincides better with the real filter structure.

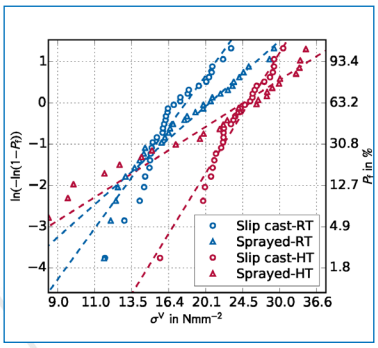


Fig. 1: Weibull failure probability plot for different specimen manufacturing processes at different temperatures.

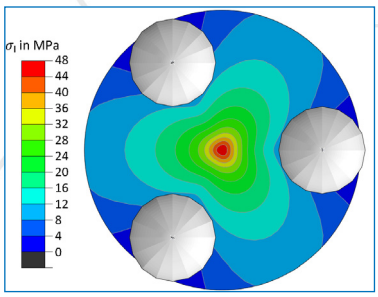


Fig. 2: Stress state at specimen bottom side.

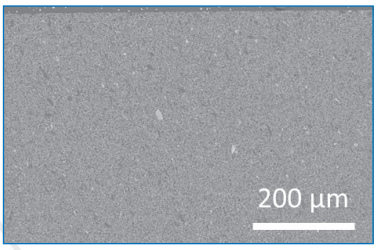


Fig. 3: Micrograph of a slip cast specimen.

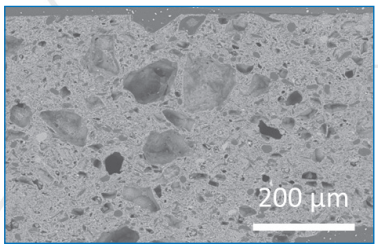


Fig. 4: Micrograph of a sprayed specimen.

[1] Soltysiak, S.; Abendroth, M.; Kuna, M.; Dudczig, S., Influence of the Content of Modified Coal Tar Pitch Powder on the Strength of Carbon Bonded Alumina (Al_2O_3–C). Adv. Eng. Mater. 2013, 15, 1230-1234.
[2] Soltysiak, S.; Abendroth, M.; Kuna, M.; Klemm, Y.; Biermann, H., Strength of fine grained carbon-bonded alumina (Al_2O_3–C) materials obtained by means of the small punch test. Ceram. Int. 2014, 40, 9555-9561.
[3] Zielke, H.; Abendroth, M.; Kuna, M., Determination of Fracture Mechanical Properties of Carbon Bonded Alumina Using Miniaturized Specimens. Key Eng. Mater. 2016, 713, 70-73.

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CURRENT PUBLICATIONS (DECEMBER 2016 – MAY 2017)

Further information about the currently 145 publications from the second program period until May 2017 as well as about the currently 17 patents and patent applications are available http://tu-freiberg.de/forschung/sfb920.

Projectarea A - Filter materials

Subproject A01

Aneziris, C. G. (2016): Multifunctional Carbon-bonded filters for metal melt filtration. Cellular Materials - CellMat 2016, 07.-09.12.2016, Dresden, Keynote Lecture.

Aneziris, C. G., Gehre, P., Schmidt, A. (2016): Carbon bonded functional filter systems for clean steel technology. 1st German-Chinese-Symposium, Development and Technology of Carbon Materials, AK Kohlenstoff, 13.11. – 16.11.2016, Berlin.

Schmidt, A., Salomon, A., Dudczig, S., Aneziris, C. G., Rafaja, D. (2016): Kinetics of the interactions of carbon-bonded alumina filter in steel contact. CellMat 2016, 07.-09.12.2016, Dresden.

Schmidt, A., Salomon, A., Dudczig, S., Berek, H., Rafaja, D., Aneziris, C. G. (2017): Functionalized Carbon-Bonded Filters with an Open Porous Alumina Coating: Impact of Time on Interactions and Steel Cleanliness. Advanced Engineering Materials, accepted: 03.05.2017, DOI 10.1002/adem.201700170.

Schröder, C., Fischer, U., Schmidt, A., Schmidt, G., Volkova, O., Aneziris, C. G. (2017): Interactions between exogenous magnesia inclusions with endogenous inclusions in a high alloyd steel melt. Advanced Engineering Materials, accepted: 18.04.2017, DOI 10.1002.201700146.

Storti, E., Dudczig, S., Hubálková, J., Gleinig, J., Weidner, A., Biermann, H., Aneziris, C. G. (2017): Impact of Nanoengineered Surfaces of Carbon-Bonded Alumina Filters on Steel Cleanliness. Advanced Engineering Materials, accepted: 03.04.2017, DOI 10.1002/adem.201700153.

Subproject A02

Voigt, C., Aneziris, C. G. (2017): Surface functionalized filters for aluminum melt filtration. 92. DKG Jahrestagung mit Symposium Hochleistungskeramik 2017, Berlin, 19.-22.03.2017, Poster, *2. Platz Poster-Wettbewerb*.

Voigt, C., Aneziris, C. G. (2017): Oberflächenfunktionalisierte Schaumkeramikfilter für die Aluminiumschmelzefiltration. Interdisziplinäre Symposium für Ingenieurinnen und Naturwissenschaftlerinnen, ISINA, 13.-14.03.2017, TU Chemnitz, Poster.

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Subproject A05

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Project area B - Modeling of filter structures/ filter systems

Subproject B01

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Subproject B04

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Subproject B05

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Subproject B06

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Project area C - Filter performance, materials properties

Subproject C01

Storti, E., Dudczig, S., Gleinig, J., Colombo, P., Aneziris, C. G., Weidner, A., Biermann, H. (2016): Investigation of carbon-bonded alumina filters by µCT after contact with a steel melt. Cellular Materials - CellMat 2016, 07.-09.12.2016, Dresden.

Subproject C03

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Zielke, H., Schmidt, A., Abendroth, M., Kuna, M., Aneziris, C. G. (2017): Influence of the specimen manufacturing process on the strength of carbon bonded alumina (Al_2O_3-C). Advanced Engineering Materials, accepted: 08.03.2017, DOI 10.1002/adem.201700083.

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Subproject C04

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Subproject C05

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Subproject C06

Fankhänel, B., Voigt, C., Stelter, M., Scharf, C., Aneziris, C. G. (2016): Spodumene, as new reactive element in aluminum filtration. Cellular Materials - CellMat 2016, 07.-09.12.2016, Dresden.

Fankhänel, B., Stelter, M., Voigt, C., Aneziris, C. G. (2017): Interaction of AlSi7Mg with oxide ceramics. Advanced Engineering Materials, accepted: 03.04.2017, DOI 10.1002/adem.201700084.

Transfer projects

Transfer project T01

Neumann, S., Schwarze, R. (2017): Sensitivity Analysis of VOF Simulations regarding Free Falling Metal Melt Jets. Clausthal-Göttingen International Workshop on Simulation Science, 27.-28.04.2017, Göttingen, Vortrag.

Wetzig, T., Aneziris, C. G. (2017): A novel gel-casting processing route based on sodium alginate to produce carbon-bonded alumina filters for steel melt filtration. 92. DKG Jahrestagung mit Symposium Hochleistungskeramik 2017, Berlin, 19.-22.03.2017, Vortrag.

Complementary subprojects

Service project S01

Hubálková, J., Voigt, C., Schmidt, A., Moritz, K., Aneziris, C. G. (2016): In-situ X-ray microtomography charaterization of damage in alumina and carbon-bonded alumina foam ceramics. Cellular Materials - CellMat 2016, 07.-09.12.2016, Dresden.

Service project S03

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Subproject Z/MGK

Aneziris, C. G. (2017): Intelligente Filterwerk stoffe und multifunktionale Filtersysteme für die Metallschmelzefiltration. Science Match 2017, Intelligente Werkstoffe und Strukturen, Veranstalter: „Der Tagesspiegel“ und Freistaat Sachsen, 26.01.2017, Dresden.

Aneziris, C. G. (2017): Beiträge der Keramik in Hochtemperatur-Anwendungen am Beispiel SFB 920: Recycling, Energie, Leichtbau. 105. Tagung der Humboldt-Gesellschaft für Wissenschaft, Kunst und Bildung e.V., Beratung des Akademischen Rates, Potsdam, 05.-07.05.2017, eingeladener Vortrag.

Patents and patent applications

Subproject A01

Producing porous or dense ceramic, metallic or metallo-ceramic complex items with improved thermos-mechanical properties. Patent application No. 10 2017 000 624.5 (25.01.2017).

Hybrid filter systems for metal melt filtration. Patent application No. 10 2017 000979.1 (03.02.2017).

Producing carbon-containing ceramic components. Patent application No. 10 2015 221 853.8 (06.11.2015), Publication: 11.05.2017.

AWARDS AND DISSERTATIONS

Dipl.- Ing. Johannes Storm, doctoral student in the CRC’s Research Training Group, successfully defended his dissertation on the “Development and evaluation of efficient calculation concepts for ceramic filters.” **Dipl.-Ing. Fabian Heuzeroth**, also doctoral student in the CRC 920, successfully finished his Ph.D. project on “Model-based investigations of filter mechanisms in ceramic foam structures.”

In March 2017, **Dr.-Ing. Claudia Voigt** received an awared for her poster presentation on the annual meeting of the German Ceramic Society DKG in Berlin. Dr.-Ing. Claudia Voigt is involved in the CRC 920 in subproject A02. In 2016 she successfully defended her dissertation on functionlized surfaces of foam ceramic filters for alumina melt filtration. ■

NEW RESEARCH EQUIPMENT

In cooperation with this industry partner a transfer project analyzes cyclic properties of steel alloys under very high load cycles and realistic temperatures.

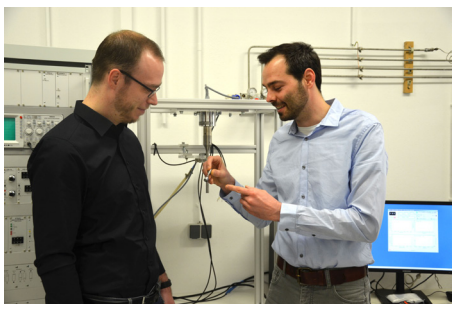

Photo (from left to right): Dipl.-Ing. A. Schmiedel and Dipl.-Ing. T. Kirste, inspecting a sample.

Prof. Horst Biermann and **Dr. Anja Weidner** are coordinating the transfer project which has been funded by the German Research Council DFG. Until 2020, novel insights into the subject of very high cycle fatigue (VHCF) under high temperatures are expected. Furthermore, the transfer project offers valuable research opportunities for young scientists. ■

CONFERENCES AND CALLS FOR PAPERS

REFRA 2017: 30.05.-01.06.2017 in Prague. Further information at http://www.silikaty.cz.

ECerS 2017: 09.-13.07.2017 in Budapest. Further information at https://ecers2017.akcongress.com.

UNITECR 2017: 25.-29.09.2017, in Santiago de Chile. Further information at http://unitecr2017.org.

DGM-WerkstoffWoche: 27.-29.09.2017 in Dresden. Further information at www.werkstoffwoche.de.

60. International Refractory Colloquium: 18.-19.10.2017 in Aachen. Further information at www.feuerfest-kolloquium.de.

8. Freiberger Feuerfestforum: 13.12.2017 in Freiberg.

IMPRESSUM

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PHOTOS
TU Bergakademie Freiberg, CRC “Multi-Functional Filters for Metal Melt Filtration - A Contribution towards Zero Defect Materials,“ Detlev Müller

ISSUE: No. 12, Issue 01/2017
(Two issues per year)

SFB 920
Multifunktionale Filter für die Metallschmelzefiltration – ein Beitrag zu Zero Defect Materials