SFB 920

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

NEWSLETTER 15 (2/2018)

DFG Deutsche Forschungsgemeinschaft

TECHNISCHE UNIVERSITÄT BERGAKADEMIE FREIBERG
Die Ressourcenuniversität. Seit 1765.

DEAR READERS,

The work accomplished by researchers of the CRC 920 “Multi-Functional Filters for Metal Melt Filtration - a Contribution towards Zero Defect Materials“ is being recognized nationwide and worldwide. In recent months, results have been published in numerous high-ranked national and international outlets. Researchers have contributed to many national and international conferences and workshops. Several awards have been assigned to researchers of the CRC 920, for their work in the CRC and for their outstanding contributions to materials research, respectively. Moreover, we congratulate several doctoral students of the CRC 920 for having successfully defended their dissertation viva.

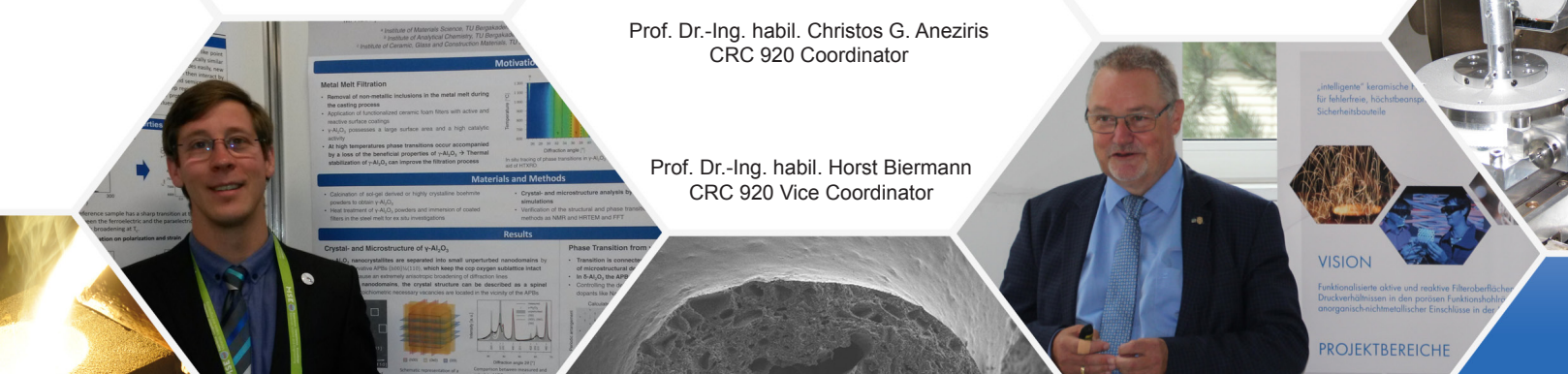
Details on recent publications and patents, our latest research results and our awardees are available in this issue of this newsletter. Further information is provided at http://sfb920.tu-freiberg.de. We hope you‘ll enjoy the newsletter.

Yours sincerely,

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

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

CONTENT



INTERNATIONALLY VISIBLE - CRC 920 ENGAGES IN CROSS-NATIONAL RESEARCH DIALOGUE

The Collaborative Research Center CRC 920 presented current results of its research on several international conferences and workshops in Italy, Poland, Brazil as well as on conferences in Germany. Project leaders and young scientists presented their results to an international audience. Sessions chaired or organized by members of the CRC 920, such as sessions on the World Foundry Congress in Krakow or the CellMAT 2018, received particular attention.

In June 2018, **Dr.-Ing. Enrico Storti, Jens Fruhstorfer, Henry Zielke, Bruno Luchini and Tony Wetzig** attended the **7th International Congress on Ceramics in Foz do Iguaçu, Brazil.** They presented recent research results of the CRC 920 "Multifunctional filters for metal melt filtration: a contribution towards zero defect materials" to an international audience, consisting of numerous representatives from academia and industry. Moreover, **invited by Prof. Dr. Victor Carlos Pandolfelli** from the Department of Materials Engineering of the Universidade Federal de São Carlos (UFSCar), they attended the **2nd International Workshop of UFSCar and CRC 920 in São Carlos**.

Also in June 2018, in Italy the **"International Conference on Modern Materials and Technologies CIMTEC"** took place. **Dr. Patrick Gehre, Dr.-Ing. Enrico Storti and Bruno Lunchini** as well as the CRC's coordinator, Prof. Dr. Christos G. Aneziris, presented research objectives and results of the CRC 920. On this occasion, **Prof. Dr. Christos G. Aneziris** received a special award: In recognition of his outstanding contributions to the research on approaches to nano- and microfunctionalize high-temperature materials he was assigned as **new member of the World Academy of Ceramics WAC**.

From 23rd to 27th of September 2018, Krakow/Poland invited to the **73rd World Foundry Congress (WFC) "Creative Foundry."** Besides contributing presentations and posters to other sessions, the **CRC 920 was responsible for organizing one session** dedicated to aspects of "technology". The session was chaired by Prof. Dr. Christos G. Anezisis, coordinator of the CRC 920.

Photo: Researchers of the CRC 920 who attended the 73rd World Foundry Congress in Krakow, Poland.

Photo (from left to right): Dr.-Ing. Tobias Fey (Co-Chair CellMAT 2018) and presenters at the "Special Session CRC 920" at CellMAT 2018.

Photo (from left to right): Hanka Becker and Eric Werzner from CRC 920 joined the initiative "Research in Germany" of the Federal Ministry of Education and Research BMBF to represent German universities at MSE 2018.

The World Foundry Congress (WFC) is the leading congress of the World Foundry Organization WFO. Every two years the congress gathers academics and industry representatives from all continents and invites them for an exchange about current developments and latest research results. This year, more than 700 experts from 41 countries participated in this event.

The CRC 920 organized another session on the **5. CellMAT 2018 – Cellular Materials**, which was held from 24th to 26th of October in Bad Staffelstein. In total, eleven presentations were given from CRC researchers. **Dr. Patrick Gehre, coordinator of the subproject A01, gave the keynote** to the CRC's session, entitled "Functionalising of cellular filtering materials for steel melt: A contribution to clean steel technologies." Since 2010, the CellMAT conference series have been dedicated to activities in manufacturing and application as well as research and development if cellular materials. Hence, CellMAT is one of the major platforms for the CRC to present research projects and results on multifunctional filter materials for metal melt filtration.

In addition to that, **Dr. Patrick Gehre served as chairman for the session "Refractory protection" held at the 61st International Refractory Colloquium in Aachen** from 26th to 27th of September 2018. At the same time, the CRC 920 took the chance to present at the **Materials Science Engineering Congress MSE in Darmstadt** as part of the initiative of the Federal Ministry of Education and Research BMBF **"Research in Germany." Dipl.-Ing. Martin Rudolph**, research assistant in subproject A05, received a **Best Poster Award** for his poster in the category "Functional materials, surfaces, and construction components." Responding to a call from the German Research Foundation DFG, young scientists of the CRC 920 participated in representing German universities at a shared booth. Moreover, they joined the "Research in Germany Science Breakfast," that invited academics and young researchers to learn more about materials science and technology as a research discipline, about career pathways, funding and options for research cooperation in Germany. ■

MORE NEWS

DISSERTATIONS AND AWARDS

Another four doctoral students of the CRC 920 have successfully finished their dissertations: **Dr.-Ing. Tilo Zienert** presented his dissertation on "Predicting heat capacity and experimental investigations in the Al-Fe and Al-Fe-Si systems as part of the CALPHAD-type assessment of the Al-Fe-Mg-Si system. **Dr.-Ing. Henry Lehmann** defended his dissertation on "Temporal lossy in-situ compression for computational fluid dynamics simulations" with outstanding results. **Dr.-Ing. Stefan Soltysiak** was assigned the title Dr.-Ing. for his dissertation on "Investigation of deformation and fatigue behavior of carbon-bonded ceramic materials using miniaturized test procedures." Finally, **Dr.-Ing. Sebastian Henschel** successfully defended his dissertation entitled "The impact of temperature and strain rate on strength, deformation and toughness of G42CrMo4 steel with varying inclusion characteristics."

Moreover, for the second time the CRC 920 assigned its publication award. **Dipl.-Ing. Johannes Solarek** and **Dipl.-Wirt.-Ing. Yvonne Ranglack-Klemm** received this award for their paper on "Ductile behaviour of fine-grained, carbon-bonded materials at elevated temperature." ■

Photo (from left to right): Prof. Dr. Lutz Krüger and Dr.-Ing. Sebastian Henschel.

INTERNATIONAL VISITING SCHOLARS

In July, the CRC 920 invited **Univ.-Prof. Dr. Robert Danzer** from the Institute of Structural and Functional Ceramics at **Montanuniversität Leoben, Austria** to visit TU Bergakademie Freiberg. For doctoral students and researchers, he offered a guest lecture on "Strength and Reliability of Ceramics."

Another guest lecture entitled "Use of carbon-based nanomaterials as coatings of ceramic foam filters" was provided by **PhD Ondřej Jankovský** from Prague University of Chemistry and Technology (VŠCHT Praha). Until September 2018, Ondřej Jankovský has been visiting the Institute of Ceramics, Glass and Construction Materials at TU Bergakademie Freiberg. Being an expert for graphene and graphene oxide, he supported research activities conducted by Prof. Christos G. Aneziris and his staff at the Department of Ceramics on carbon-containing refractory materials as key components for metallurgic purposes.

Holding a **RISE scholarship**, **Mathew Bolan** from **University of Guelph, Canada**, contributed to the research in subproject A07 (Prof. Andreas Leineweber, Dipl.-Ing. Hanka Becker). From May 15 to August 15, 2018, he was involved with research tasks regarding the "Formation of iron-containing intermetallic precipitates in Al-Si alloys with Fe impurity." ■

Photo: Univ.-Prof. Dr. Robert Danzer from Montanuniversität Leoben, Austria.

JUNIOR RESEARCHERS

Research assistants of the CRC 920 contributed to several activities aimed to promote materials science and technology as a research discipline. In June 2018, **eleventh graders from Lößnitz Secondary School Radebeul** visited the Institute of Ceramics, Glass and Construction Materials, in order to explore the world of ceramic materials and its diverse applications. Participating in practical courses in different laboratories and testing facilities at the institute, students obtained valuable insights into the manufacturing of ceramics and related procedures to test relevant materials properties. Also in June 2018, eighth, tenth and eleventh graders from the **Geschwister-Scholl Secondary School Freiberg** were invited to a **meeting day** dedicated to "Ceramics in our daily lifes: How ceramics relate to leaky water taps and cars." ■

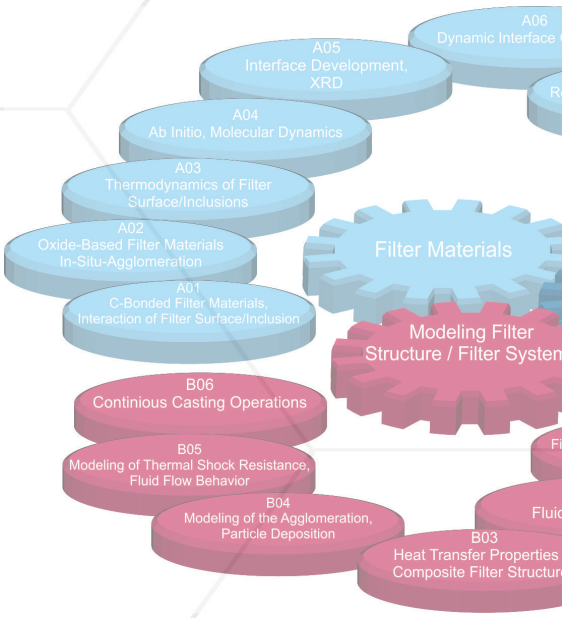
Photo (from right to left): Dr.-Ing. Nora Brachhold and Dr.-Ing. Nora Gerlach explaining the manufacturing of ceramic components using pressure lubrication casting to students from the Lößnitz Secondary School Radebeul.

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.

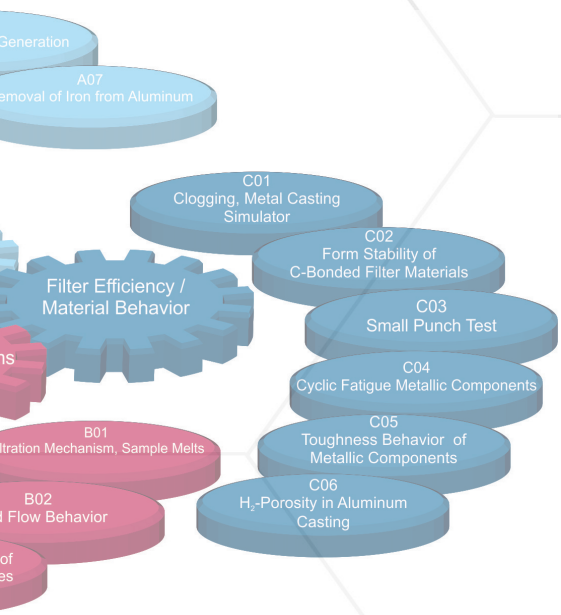
Working Group 1: "Metal melt/inclusions, active/reactive filter material, boundary surface design" (Coordination: Dr.-Ing. Claudia Voigt)

- Upscaling investigations on carbon-bonded alumina spaghetti filters for industrial applications by applying extrusion as robot-assisted gel-casting based on alginates with the aid of suitable organic plasticizers and binders (T01).
- Investigation of the influence of the filter roughness on the filtration efficiency during the aluminum melt filtration with ceramic foam filters (A02, S03).
- Preparation of water-soluble polyvinyl alcohol (PVA) filter skeletons by selective laser sintering and investigation of a water-stable Al_2O_3-C coating (A01).
- Investigation of the reactive interaction of a Fe-containing, secondary Al-Si alloy in no-flow contact with different filter materials (A07).
- TEM analyses of FIB-cut lamellae of interfaces between steel melt and Al_2O_3(-C) with different carbon contents (0.4 and 30 mass%) and produced with different methods (SPS and steel casting simulator) have been finished. An amorphous interlayer consisting mainly of O and Fe could be identified for the short-time treated samples (less than 120 s) as a characteristic feature independent from the carbon content and the sample treatment (A06).
- Thermodynamic assessment of the Al_2O_3-MnO system including c_p measurements for the intermediate Al_2O_3-MnO compound (spinel Al_2MnO_4) between -30 and 800 °C (A03).
- Investigations concerning the reduction of H_2-porosity in aluminum castings by using reactive filters in melt filtration (C06).
- Immersion tests (steel casting simulator) of prismatic filters with different coatings (CNT's, graphene) as well as immersion test of the uncoated alumina-carbon base material in steel melts with different compositions (oxygen, carbon, aluminum-content) have been performed to characterize the filtration of inclusions as well as the in-situ formation of secondary alumina layers. (C01).



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

- Investigation of the impact of inserted micro- and nanobubbles on adhesion forces under variation of roughness and gas oversaturation (B01).
- Characterization of the agglomeration of hydrophobic particles in electrolyte solutions by UV-Vis-spectroscopy (B04).
- Investigation of the influence of the axial variation of pore count on filtration inside composite filters using the water test facility (B01).
- Computation of turbulent flow and filtration efficiency with due regard to the experimental conditions during filtration inside the steel casting simulator facility employing large eddy simulation and tracking of inclusions (B02, C01).
- CFD simulations to investigate the effect of carbon monoxide bubbles on the cleanliness of the melt in case of reactive cleaning (B06, A03, A01, C01).
- Large eddy simulations of the flow behavior in a tundish including models for the active filtration and reactive cleaning of non-metallic inclusions using exchangeable filters (T01, B06).
- Evaluation of mechanical and hydrodynamic characteristics for artificial foam models considering polydisperse and anisotropic pores (B05, B02).
- Measurement of the hemispheric transmission of different filter structures with the external integrating sphere and investigations aiming at a more precise determination of temperature and velocity during the casting experiments (B03).
- Development of a reduced theoretical model for the determination of the Forchheimer coefficient of anisotropic filter structures (B02).
- Production of a comprehensive data set from detailed filtration simulations for automated analyses on Taurus Bull cluster at ZIH Dresden (S02).



Working Group 4: "Mechanical properties, metallic materials, critical inclusions" (Coordination: Dr.-Ing. Sebastian Henschel)

- Mechanical characterization of the "finger tests" (42CrMo4) with respect to strength, ductility, fracture toughness, fatigue lifetime and damaging inclusions (C04, C05).
- Non-metallic inclusions were separated from the steel matrix of the finger test samples by acidic or electrolytic extraction to investigate the morphology of the different types of inclusions (C04).
- Plate-like Al_2O_3 inclusions with thickness of 0.5 – 1 µm and size of 50 – 100 µm were identified as crack initiating inclusions at fracture surfaces of both fatigue samples and tensile test samples from "finger tests". Some of them showed agglomeration with other plate-like Al_2O_3 inclusions. Fatigue properties were found to be sensitive to the maximum inclusion size, whereas the total amount of non-metallic inclusions or smaller inclusion population had no noticeable effect on fatigue. The ductility and the energy dissipation were, in contrast, affected by the volume fraction of the non-metallic inclusions (C04, C05).
- The non-metallic inclusion (NMI) size distribution analysis based on maximum Feret's diameter (instead of area) was found to be an effective method for detecting plate-shaped inclusions on metallographic sections. It was observed that plate-like NMIs initiate the crack with all their area even being inclined to the crack plane. Formation of alumina NMI as a plate lead to significant enlargement of its stress-concentrating area in comparison to the spherical shape of the same volume (C04).
- By means of TEM investigations on FIB lamellae taken from a cyclically fatigued sample in the vicinity of the crack initiating inclusion, the formation of a so-called fine granular area (FGA) around the crack initiating inclusion as a failure mechanism could be proven (C04).
- For the automated quantitative inclusion analysis at the ASPEX microscope, a new analysis algorithm was developed with the help of qualitative inclusion analyses at the SEM, which allows the classification of the different inclusion types present in the steel 42CrMo4 on the basis of their chemical composition. The result shows that the ceramics used in the finger test experiments, in addition to the Al_2O_3 inclusions already present, lead to different amounts of mixed oxides (C04).
- As a second alloy, cast AlSi9Cu3 is analyzed with regard to its microstructure. The focus here is on influencing the development of the intermetallic phases as a function of different Fe contents (S03, C04, C06).
- The crack initiation toughness was modelled by using parameters describing the temperature and rate dependent strength and deformation behavior as well as information on the inclusion distribution. The metallographically-measured average inclusion diameter and the fractographically-determined density of inclusions are relevant for modelling the materials resistance against crack initiation. The fractographic determination of the inclusion density needs high experimental effort. Hence, this characteristic was derived from the metallographic density with the help of a simulation (C05).

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

- Comparison of filter strengths and strut diameter of different filter production routes (produced and tested by A01) with those of artificially generated foams (B05).
- Adaptation of the structural stiffness of the artificially generated foams (B05) to real foam samples (C02) on the basis of computer tomographic images (S01).
- Fracture mechanics on compact Al_2O_3-C specimens in 4-point bending tests at 1400 °C with / without partial relief for crack length determination (C02).
- Acoustic emission of compact Al_2O_3-C specimens in a 4-point bending test at room temperature (elimination of interfering signals) (C02).
- Creep tests on foam filter structures at 1350 °C for simulation in TP B05 (C02).
- Performance of B3B experiments at 1500 °C (C03) and determination of plastic strains.
- Preparation of numerical simulation of the B3B experiments at 1500 °C taking into account damage mechanical approaches (C03).

DETERMINATION OF THE FLOW RESISTANCE OF FILTER FOAMS IN THE FORCHHEIMER REGIME

Authors: Eric Werzner, Cornelius Demuth (subproject B02)

Subproject B02 investigates the filtration process inside complex filter structures by means of pore-scale numerical simulations of liquid metal flow and inclusion motion. A novel method might enable the prediction of the pressure loss of anisotropic structures in the inertial regime without time-consuming calculations.

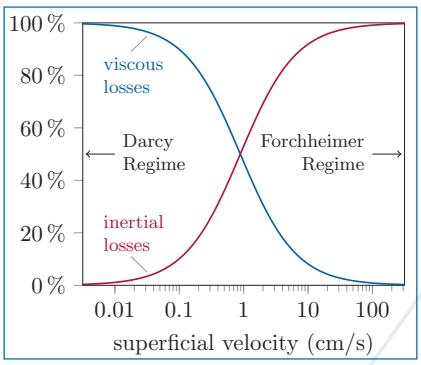


Figure 1: Variation of viscous and inertial contributions to the overall pressure drop with respect to the flow velocity during steel filtration (10 ppi Al_2O_3-C filter, porosity ε = 80 %, steel AISI4142, 1600 °C).

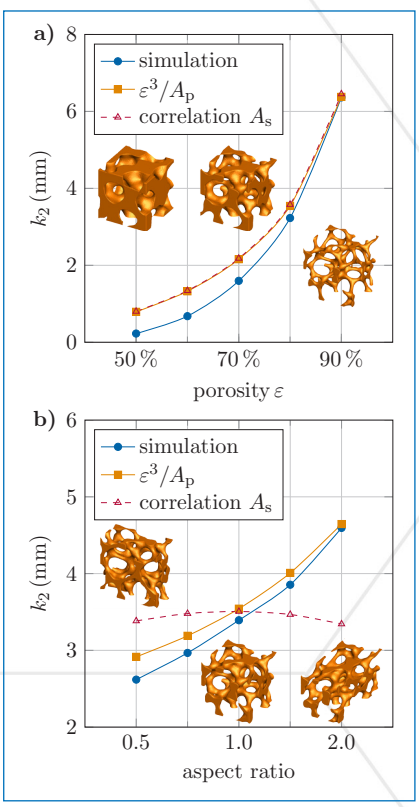


Figure 2: Variation of the inertial permeability k_2 with a) the porosity for isotropic foams and b) the aspect ratio at ε = 80 %. The illustrations show small sections of the investigated geometries.

In addition to the good filtration performance, an improved foam structure for molten metal filtration has to also meet exacting requirements concerning pressure drop as well as resistance to infiltration and thermal shock. This inevitably leads to a conflict of objectives, so that the assessment of new designs requires an overall evaluation. Although high-resolution numerical simulations permit a nearly complete characterization of the filter structures, they involve a high computational effort. Particularly in the early stages of development, when a preselection among many variants has to be made, this approach may be infeasible. On the other hand, simplified models or correlations, which base directly on the detailed geometry or its statistical properties, constitute an alternative [1]. The present work in subproject B02 includes the development of such a method for the determination of the pressure loss in the Forchheimer regime.

Figure 1 shows the variation of the viscous and inertial contributions to the total pressure drop for a 10 ppi Al_2O_3-C foam during steel filtration with respect to flow velocity. At the high velocities, present during gravity casting, almost exclusively inertial losses are effective (Forchheimer regime). In this regime, the pressure loss can be predicted by the Forchheimer law, which requires only a single material parameter of the foam to be known, namely the inertial permeability coefficient k_2.

For the simplified determination of k_2, correlations in the form of Ergun equation are typically used, which are based on the specific surface area A_s or the hydraulic diameter of the geometry [2]. However, these characteristics only indirectly relate to the physical reasons for pressure drop in the Forchheimer regime, which leads to the necessity for coefficients. For the same reason, these correlations are unable to make predictions for anisotropic structures, which gain more interest as additive manufacturing becomes increasingly available.

From the macroscopic balance of the pressure force and the temporal momentum exchange of the melt with the filter struts, an extremely simple theoretical model in the form $k_2 = \varepsilon^3/A_p$ was found, which is based on the specific area, projected by the filter struts along the flow direction, A_p [3]. If a voxel representation of the geometry is available, A_p can be calculated directly from the summation over the corresponding wall voxels. Since the operation is local, it can also be efficiently parallelized.

The new approach was tested by comparison with data from detailed numerical simulations for artificial foam structures from subproject B05, whose geometric properties can be purposefully adjusted [4]. First, the influence of porosity ε for isotropic foams was investigated. The results, presented in Figure 2a, show that the developed reduced model allows accurate predictions in the porosity range of 80 – 90 %, typical for metal melt filters. Since the ratio A_s/A_p remains constant for the isotropic case, the results agree with that of a correspondingly adapted correlation based on A_s. This, however, changes drastically for anisotropic foams, which were generated in this study by varying the aspect ratio of the foam skeleton. As can be observed from Figure 2b, only the A_p-based model predicts the expected variation of k_2 with respect to aspect ratio, while showing significantly less error than the Ergun-type correlation.

After further testing, the present approach is intended to be employed in the framework of a virtual prototyping of filter structures, in order to support the flow-related evaluation of the geometries. ■

[1] M. A.A. Mendes, S. Ray, D. Trimis, Int. J. Heat Mass Transfer 2013, 66, 412-422
[2] B. Dietrich, Chem. Eng. Sci. 2012, 74, 192-199
[3] E. Werzner, C. Demuth, S. Ray, MSE Congress, 26.-28.09.2018, Darmstadt
[4] E. Werzner, M. Abendroth, C. Demuth, Ch. Settgast, D. Trimis, H. Krause, S. Ray, Adv. Eng. Mater. 2017, 19 (9), 1700240

NON-METALLIC INCLUSIONS AND THE FATIGUE BEHAVIOR OF ALLOYS

Subproject C04 investigates non-metallic inclusions in cast samples, which have been treated with various ceramics, using the cyclic loading method. Analyses focus on failure-critical inclusions in the material and mechanical fatigue, in order to provide a detailed characterization of the non-filtered non-metallic inclusions.

Author: Johannes Gleinig
(Subproject C04)

In the present work the effect of different crucible materials on the resulting inclusions in the steel alloy 18CrNiMo7-6 is investigated. Therefore the steel alloy was melted in the steel casting simulator and kept in contact with the carbon-bonded crucible materials used for 60 minutes at 1580 °C (SP C01). Three reactive carbon-bonded ceramics were used: (i) aluminium oxide (A-C), (ii) a mixture of alumina, zirconia and titania (AZT-C) and (iii) the AZT-C mixture with the addition of carbon nanotubes and alumina nanosheets (AZT-C-n). The test results obtained from the controlled cooling and solidification of the steel batches are presented below. Before mechanical testing the material was subjected to hot isostatic pressing to close existing solidification cavities and pores.

The inclusion types identified in the solidified steel batches do not differ qualitatively from each other for the three crucible materials used. In all cases, sulfides and so-called duplex inclusions consisting of an oxide core surrounded by a sulfide shell were found in the majority of cases. However, with regard to the size distribution and frequency of the inclusions (Fig. 1), significant differences can be observed between the steel batches treated with different crucible materials. It is obvious that when using the AZT-C-n crucible, fewer small inclusions are observed, but at the same time the overall largest inclusions are present. In contrast, the use of A-C crucible material results in a significantly higher number of small inclusions and, in addition, significantly smaller maximum inclusion sizes compared to both AZT materials.

In the size distributions considering for each inclusion type separately, the dominance of sulfides (Fig. 1a) is noticeable for large inclusions. On the other hand, duplex particles (Fig. 1b) are generally smaller, whereby their frequency differs significantly between the three batches. This observation is also reflected in the measured inclusion density (Fig. 2). While the density of the sulfides is almost constant, there is a clear difference in density for the duplex inclusions, whose fraction in the A-C batch is many times higher than that in the two AZT-C(-n) batches. The oxygen content in steel batches is the main reason for the varying duplex density. As shown on the basis of a chemical analysis, the oxygen content (added in Fig. 2), in contrast to other inclusion-forming elements, is significantly influenced by the respective crucible treatment.

The often complex structure and the chemical composition were examined more closely by scanning electron microscopy. It was found that the sulfides are mostly present in polycrystalline form, whereas the oxides can be chemically very diverse and often consist of inhomogeneous oxidic compounds (e.g., mullite, amorphous silicon oxides and titanium oxides). Thereby the oxides serve as nuclei for sulfides and ultimately forming the centre parts of the duplex particles.

The morphology of the oxide cores was investigated using the acid extraction method. Different types of oxide cores (satellite, network-like, polygonal) were identified, which indicate the state of the oxides in liquid form during sulfide nucleation. In addition, the formation of oxide inclusions from numerous small nanoscale oxide spheres was observed, which most probably formed endogenously and then agglomerated.

The results of the fatigue tests performed on the sample material obtained (Fig. 3) clearly reflect the effect that the maximum inclusion size (cf. Fig. 1) has on the cyclic mechanical properties. In contrast, tests under static load (SP C05) showed the influence of the inclusion density on the resulting energy dissipation. Thus, the more numerous inclusions within the A-C batch yielded lower energy dissipation values than the AZT-C batches.

Overall, it was found that the alloy melt is chemically altered by contact with the crucible material, which in turn influences the inclusion distribution or density and thus the resulting material properties. ■

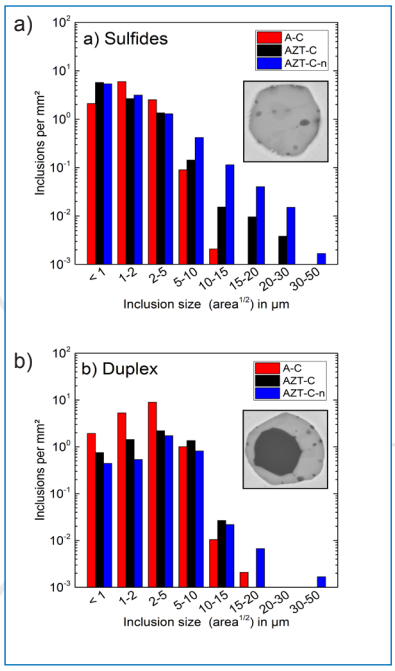


Figure 1: Inclusion size distributions obtained on the basis of polished sections (2D) classified according to sulfide and duplex inclusions.

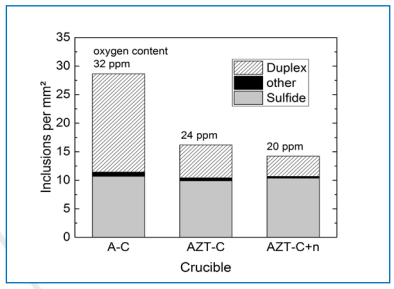


Figure 2: Inclusion density classified according to inclusion types of the alloy treated with the various crucibles.

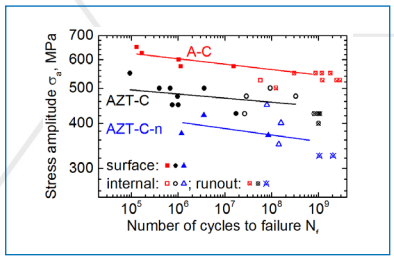


Figure 3: Fatigue strength (S-N-curve) of the alloy treated with three different crucibles.

S. Henschel et al., Adv. Eng. Mater. 2017, 19, 1700199 (1-12); J. Gleinig et al., Metall. Mater. Trans. B 2018, 213, 427-446

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CURRENT PUBLICATIONS (JUNE - NOVEMBER 2018)

Further information about the more than 300 publications from the second program period until November 2018 as well as about the currently 13 patents and patent applications are available at http://tu-freiberg.de/forschung/sfb920.

Projectarea A - Filter materials

Subproject A01

Bock, B., Schmidt, A., Sniezek, E., Dudczig, S., Schmidt, G., Szczerba, J., Aneziris, C. G. (2018): Spinel forming Systems (Fe-/Mg-/Mn-Al-O) as Functional Coating on Al_2O_3-C Filters for Steel Melt Filtration, CellMAT 2018, Bad Staffelstein, presentation.

Bock, B., Schmidt, A., Sniezek, E., Dudczig, S., Schmidt, G., Szczerba, J., Aneziris, C. G. (2018): Spinel forming systems (Mg-/Fe-/Mn-Al-O) as functional coating material on carbon-bonded filters for steel melt filtration, Proceedings of 73rd WFC 2018, Krakow, Poland, poster, pp. 29-30, ISBN 978-83-904306-3-8.

Gehre, P., Schmidt, A., Storti, E., Dudczig, S., Hubálková, J., Aneziris, C. G. (2018): Functionalisation of cellular filtering materials for steel melt: A contribution to clean steel technologies, CellMAT 2018, Bad Staffelstein, Keynote Lecture.

Herdering, A., Abendroth, M., Gehre, P., Hubálková, J., Aneziris, C. G. (2018): Additive manufactured polyamide foams with periodic grid as templates for the production of functional coated carbon-bonded alumina foam filters, Ceramics International, pp. 1-29, DOI 10.1016/j.ceramint.2018.09.146.

Jankovský, O., Storti, E., Schmidt, G., Dudczig, S., Sofer, Z., Aneziris, C. G. (2018): Unique wettability phenomenon of carbon-bonded alumina with advanced nanocoating, Applied Materials Today, Vol.13, pp. 24-31.

Luz, A. P., Consoni, L. B., Pagliosa, C., Aneziris, C. G., Pandolfelli, V. C. (2018): Sintering effect of calcium carbonate in high-alumina refractory castables, Ceramics International, Vol. 44, Iss. 9, pp. 10486-10497.

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Subproject A03

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Subproject A04

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Subproject A05

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Subproject A06

Salomon, A., Amirkhanyan, L., Ullrich, C., Motylenko, M., Fabrichnaya, O., Kortus, J., Rafaja, D. (2018): Interface reactions between rutile coatings and molten aluminium or AlSi7Mg0.6 alloy, Journal of the European Ceramic Society, Vol. 38, Iss. 16, pp. 5590-5600.

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Project area B - Modeling of filter structures/ filter systems

Subproject B01

Ditscherlein, L. Gulden, S. J., Müller, S., Baumann, R.-P., Peuker, U. A. (2018): Measuring interactions between yeast cells and a micro-sized air bubble via atomic force microscopy, Journal of Colloid and Interface Science, Vol. 532, pp. 689-699.

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Subproject B02

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Subproject B04

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Subproject B05

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Project area C - Filter performance, materials properties

Subproject C01

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Luchini, B., Grabenhorst, J., Fruhstorfer, J., Pandolfelli, V. C., Aneziris, C. G. (2018): On the nonlinear mechanical behavior of carbon-bonded alumina at high temperatures, ICC 7, Foz do Iguacu, Brazil, presentation.

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Subproject C02

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Subproject C03

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Subproject C04

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Subproject C06

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Transfer projects

Transfer project T01

Wetzig, T., Baaske, A., Karrasch, S., Brachhold, N., Rudolph, M., Aneziris, C. G. (2018): Application of exchangeable carbon-bonded alumina foam filters in an industrial tundish for the continuous casting of steel. Ceramic International, pp. 1-11, DOI 10.1016/j.ceramint.2018.09.105.

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Service projects

Service project S01

Moritz, K., Dietze, C., Voigt, C., Hubálková, J., Schmidt, A., Aneziris, C. G. (2018): Porous ceramic coatings on carbon-bonded alumina foam filters by electrophoretic deposition, CellMAT 2018, Bad Staffelstein, presentation.

Servic project S02

Lehmann, H., Werzner, E., Demuth, C., Reh, S., Jung, B. (2018): Efficient Visualization of Large-Scale Metal Melt Flow Simulations using Lossy In-Situ Tabular Encoding for Query-Driven Analytics, CSE-2018, Bucarest, Romania, pp. 123-131, DOI 10.1109/CSE.2018.00024.

Service project S03

Dietrich, B., Becker, H., Smolka, M., Keßler, A., Leineweber, A., Wolf. G. (2018): Influence of Mn and Cr on intermetallic sludge formation in Fe containing secondary AlSi9Cu3 alloy with aim of reducing Fe level by filtration, Proceedings of the 73rd WFC 2018, Krakow, Poland, pp. 307-308, ISBN 978-83-904306-3-8.

Patents and patent applications

Subproject A01

Process for generating porous or dense ceramic, metallic or metallo-ceramic, complex products with improved thermo-mechanical properties, PCT - patent application No. PCT/EP2018/051864, Filing date: 25.01.2018, Publication date: 02.08.2018.

Ceramic filters for metal melting, patent application. Patent No. 10 2018 201 577.5, Filing date: 05.02.2018, Publication date: 09.08.2018.

Subproject C02

Process for generating components with locally defined, different physical density and/or porosity. Patent No. 10 2016 212 474, patent granted: 09.08.2018, Publication of patent specification: 09.08.2018.

CONFERENCES AND CALLS FOR PAPERS

9. Freiberg Refractory Forum: 12.12.2018 in Freiberg; more information available at: https://more-freiberg.de/images/File/2018/Freiberger_Feuerfestforum_2018.pdf.

TMS 2019 Annual Meeting & Exhibition: 10.-14.03.2019 in San Antonio, Texas, USA; more information available at: https://www.tms.org/tms2019.

DKG Annual Meeting 2019: 05.05.-08.05.2019, Montanuniversität Leoben, Austria; more information available at: http://www.2019.dkg.de/info/home/en.

IMPRESSUM

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PHOTOS
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