SFB 920

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

NEWSLETTER 14 (1/2018)

DFG Deutsche Forschungsgemeinschaft

TECHNISCHE UNIVERSITÄT BERGAKADEMIE FREIBERG
Die Ressourcenuniversität. Seit 1765.

DEAR READERS,

Researchers involved in CRC 920 „Multi-Functional Filters for Metal Melt Filtration – A Contribution towards Zero Defect Materials“ continued their efforts to present their projects and research results at conferences, workshops and fairs to experts from academia and industry. These occasions offer several benefits particularly for young researchers: They get the chance to present themselves to an international audience and to initiate fruitful exchanges and collaborations with researchers and experts from other national and international research institutions. Moreover, visiting scholars are regularly enriching research and education in specific areas.

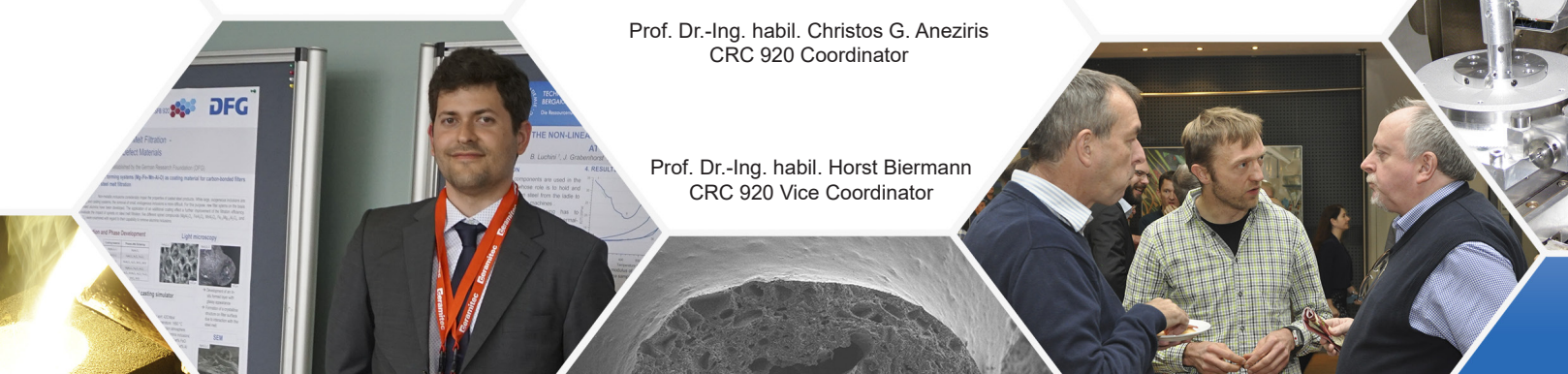
Details on related activities and results are available in our latest issue of this newsletter. Further information is provided at http://sfb920.tu-freiberg.de. We hope you'll enjoy the newsletter.

Yours sincerely,

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

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

CONTENT



INTERNATIONAL EXCHANGE ON FORUMS, FAIRS AND COMMON WORKSHOPS

High-technoloy products of the future are based on high-pure, accurate materials. Their characteristics and functions represent a technological challenge on innovative manufacturing processes, higher product qualities, longer lifecycles, up to ways to decrease the waste of valuable resources. The Collaborative Research Center CRC 920 "Multi-Functional Filters for Metal Melt Filtration – A Contribution towards Zero Defect Materials" presented its recent research results at several national and international conferences, including the 8th Freiberg Refractory Forum and the 93rd DKG Annual Meeting in conjunction with the ceramitec 2018.

Besides the investigation and application of refractory materials for metal melt filtration and for steel and non-ferrous metallurgy, deployment of refractory components for cement manufacturing and microwave sintering of ceramic composites were in the focus of the 8th Freiberg Refractory Forum. The event gathered about 120 attendees from academia, industry and professional associations. Dr.-Ing. Enrico Storti, research assistant in the Collaborative Research Center (CRC) 920, presented findings of his studies on the development of functionalized ceramic filters for metal melt filtration. Moreover, a poster session presented the research of the CRC subprojects.

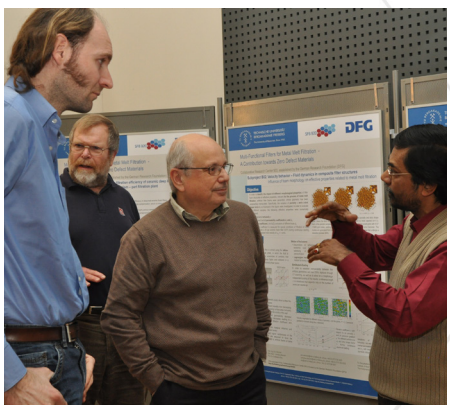


Photo: Participators of the 8th Freiberg Refractory Forum during a poster presentation.

In December 2017 the CRC 920 hosted a common workshop with eleven representatives of the Foseco International Ltd. from the UK, the Netherlands and USA. The „International Workshop of Foseco International and CRC 920 could be used to create a direct, international exchange between a producer and user of productsfor metal melt filtration.

Another important event was the 93rd DKG Annual Meeting in conjunction with the ceramitec 2018, which took place in Munich in April 2018. Members of the CRC 920 took the opportunity to present their research and discuss with partners from academia and industry projects, findings and impacts of the work delivered by both researchers and doctoral students. In total six submissions from the CRC had been presented at the conference.

Photo: Dr.-Ing. Jana Hubálková and Dr.-Ing. Steffen Dudczig at the common exhibition stand at the ceramitec 2018.

The Institute of Ceramics, Glass and Construction Materials, the Institute of Thermal Engineering and the CRC 920 presented theirselfs on a common exhibition stand at the ceramitec 2018. The ceramitec is the leading fair of the international ceramic industry and takes plakes every three years. It provides a plattform for every part of the value chain including teaching and research facilities. During a common trip to Munich PhD students of the CRC 920 had the chance to gain knowledge of the latest manufacturing processes, product applications, analysis techniques and research trends. Furthermore they were encouraged to establish personal networks.

M.Sc. Bruno Luchini, doctoral student in the CRC 920, received a third award for his poster on non-linear behaviors of carbon-bonded aluminium oxide in high-temperature applications at the 93rd DKG Annual Meeting. Since 2017, Bruno Luchini is research assistant at the Institute of Ceramics, Glass and Construction Materials at TU Bergakademie Freiberg and doctoral student in the CRC 920. After his studies in Brazil and France, he successfully finished his master thesis at the Universidade Federal de São Carlos/Brazil. His research focused on the testing and modelling of high-temperature properties of ceramic materials.

Photo: Award for M.Sc. Bruno Luchini (on the right side).

International experts, whose scientific papers are highly regarded, provide an important contribution to the qualification of the CRC 920's PhD students. Among others Prof. Véronique Favier from Arts et Métiers Paris Tech - PIMM from France presented newest insights on the influence of fatigue under cyclical stress on the expectancy of metallic components. On the field of high-temperature behaviour of refractories Adj. Professor Dr. Shengli Jin from the Montan University Leoben in Austria could be acquired.■

MORE NEWS

GUEST RESEARCHERS

Holding a scholarship of the **Alexander von Humboldt foundation PhD Ondřej Jankovský** from the University of Chemistry and Technology in Prag (VŠCHT Praha) will join the CRC 920's team from March until August 2018. Specifically he will support the research regarding carbonaceous refractories as key components for the metallurgy of Prof. Christos G. Aneziris, professorship ceramic at the Institute of Ceramics, Glass and Construction Materials.

Mr. PhD Jankovský is a young, international approved and leading expert in the field of graphene and graphene oxide with special application to ceramic materials and their production. During his present research work he can already look back to more than 65 scientifical journal publications (database: „scopus")

While his stay in Freiberg Mr. PhD Jankovský will support the research regarding creation and thermomechanical evaluation of graphene containing surfaces on carbonaceous filter materials that is run by the CRC 920 „Multi-Functional Filters for Metal Melt Filtration - A Contribution towards Zero Defect Materials". ■

Photo: Alexander von Humboldt scholarship holder PhD Ondřej Jankovský (left) shows a solution of carbon to Dr. Enrico Storti.

RESEARCH STAY IN NORWAY

From October 2017 until March 2018 **Dipl.-Ing. Hanka Becker** took the chance to spend a research stay at the **Norwegian University of Science and Technology (NTNU).** With 22,000 students the NTNU is the second largest university of Norway. It has the main responsibility for technological research and education in Norway.

Ms. Becker followd an inivitation made by Professor Yanjun Li, manager of the research group „Casting and Solidification". At the NTNU in Trondheim Hanka Becker completed some of the work of subproject A07 that deals with the removal of Fe from secondary Aluminum by metal melt filtration. „In the research group I found best conditions to work concentrated and intensively", Ms. Becker summarizes her stay.

Especially intense discussions took place during the visit of **Prof. Andreas Leineweber** from the institute of material's science and coordinator of the CRC 920's subproject A07 at the beginning of March 2018. Both research results and common research interests were discussed. Furthermore a visit of Prof. Yanjun Li in Freiberg was encouraged at the meeting.■

Photo: Exchange of knowledge at the NTNU in Trondheim, Norway.
Standing row from left to right: Bjørn Holmedal, Knut Marthinsen (NTNU Tronddheim), Andreas Leineweber (TU Freiberg), Yanjun Li (NTNU Trondheim), Hanka Becker (TU Freiberg). Sitting: Students and postdocs from the research group „Casting and Solidification".

NEW CRC 920 CORPORATE FILM

Since December 2017 the CRC 920 presents itself with a new corporate film. Under the headline „Smart filters for more safety" the film reveals interesting insights in the research of CRC 920.

The film was developed in cooperation with the film production company avec-film in Freiberg. Complementing the CRC 920's newsletter and homepage, the corporate film will be used for public relation work. The two parts - each approximately seven minutes long - can be accessed via the following URL or by scanning the QR-code below: http://tu-freiberg.de/forschung/sfb920/test/imagefilm ■

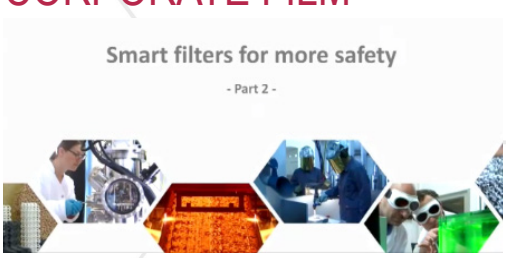


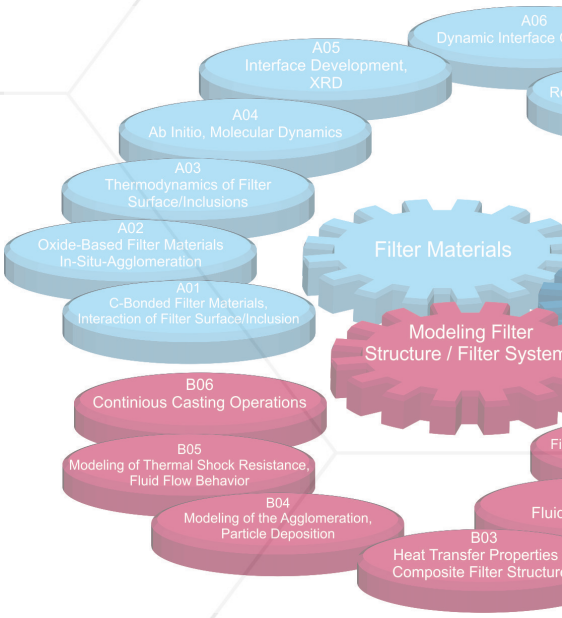
Photo: Preview from the new CRC 920's corporate film.

WORKING GROUP'S 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 coordination 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.

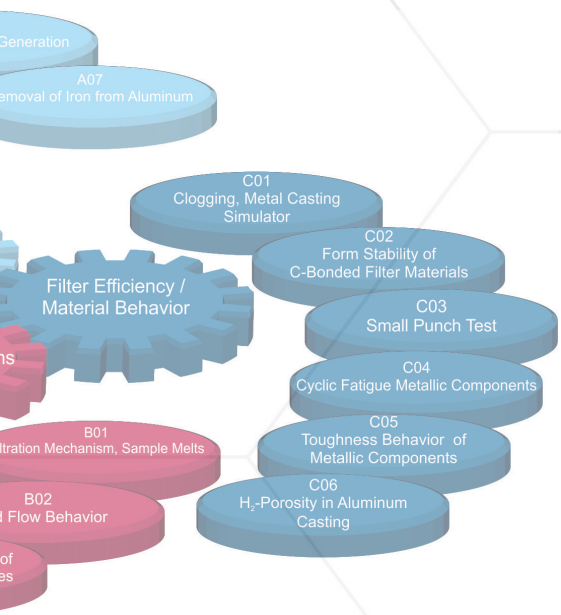
Working Group 1: „Metal melt/inclusions, active/reactive filter material, boundary surface design“ (Coordination: Dr.-Ing. Claudia Voigt)

- Successful immersion test of large-size, exchangeable ceramic foam filters based on carbon-bonded alumina in the tundish of the continuous casting plant Bruckhausen (thyssenkrupp Steel Europe AG) with 45 minutes test duration and subsequent damage-free filter removal (T01).
- Investigation of the influence of the wetting behavior on the filtration efficiency during the aluminum melt filtration with ceramic foam filters (A02, B01, B02).
- Preparation of spinel coated ($MgAl_2O_4$, $FeAl_2O_4$, $MnAl_2O_4$, $Fe_{0,5}Mg_{0,5}Al_2O_4$ and $Fe_{0,5}Mn_{0,5}Al_2O_4$) ceramic foam filters and characterization of these filters before and after immersion tests with 42MoCr4 in the steel casting simulator (A01, C01).
- Investigation of structural differences of manganese containing β- and δ-Al-Fe-Si-phases prepared with different holding times and cooling rates (A07).
- TEM analyses of FIB-prepared interfaces between rutile and hetero-epitaxially grown layers of corundum or $MgTiO_3$ after contact with molten aluminum or molten aluminum alloy AlSi7Mg0.6, respectively, confirmed previously found defined orientation relationships as well as deviations induced by geometrically necessary dislocations and showed a severe influence of impurities on the sequence of phase formation (A06).
- Investigation of the influence of anti-phase boundaries on the high temperature phase transition of metastable alumina (A05).
- Experimental investigation and thermodynamic modelling of the binary MgO-TiO_2 system and the ternary Al_2O_3-MgO-TiO_2 system (A03).
- Successful application of spodumene containing filter materials in lab scale to reduce hydrogen porosity in casting products (C06, A02).
- Industry-oriented casting trials (100 kg 42CrMo4) of ceramic foam filters in the metal casting simulator (C01, A01, T01).



Working Group 2: „Modeling and designing of the filter geometry“ (Coordination: Dipl.-Ing. Eric Werzner)

- Heterocoagulates, generated in the course of investigating the influence of microbubbles on the filtration inside ceramic depth filters using the water model, were observed to reduce the filtration efficiency (B01).
- Analysis of repulsion and interaction forces between colloidal probe particles (AFM) and microbubble interfaces as well as investigations on the impact of morphology of hydrophobic surfaces on wetting heterogeneities (B04).
- LBM-DNS solutions of the turbulent flow inside the filter reveal very high turbulence intensity as well as an energy cascade with narrow inertial range and smallest structures of just few micrometers in size, while time-integrated statistics could be accurately predicted using the wall-adaptive LES model (B02).
- Extension of the artificial foam models for a consideration of polydisperse and anisotropic pores as well as numerical investigations regarding their influence on the foam stiffness (B05).
- Numerical study on the effect of arising carbon monoxide bubbles on the cleanliness of the melt in the tundish (B06, C01).
- Designing of an experiment to investigate the sensitivity of the tundish flow with respect to immersed filters and analysis of molten steel flow in an industrial tundish using the numerical solver developed in B06 (T01).
- Automated visualization of vortices inside an artificial foam structure from high-resolution transient solution data (3 TB size), which have been compressed and indexed during the simulation on the high performance computer (ZIH) for accelerated post-processing (S02, B02, B05).



Working Group 4: „Mechanial properties, metallic materials, critical inclusions“ (Coordinator: Dipl.-Ing. Sebastian Henschel)

- Mechanical characterization of the “finger tests” FT7 to FT9 (42CrMo4) with respect to strength, ductility, fracture toughness, fatigue lifetime and damaging inclusions (C04, C05).
- Electrolytic extraction of non-metallic inclusions for detailed analysis of the inclusion morphology in the solidified steel (C04).
- Plate-like Al_2O_3 inclusions 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 or angular Al2O3 inclusions (C04, C05).
- Non-metallic inclusions having a diameter of approximately 50-60 µm initiate the crack at VHCF loading. Differences in the amount of small inclusions for different casts had a minor impact on the fatigue life time (C04).
- Improvement of the developed rule file, for a better classification of the non-metallic inclusions regarding their chemical composition and inclusion types analyzed with ASPEX (C04).
- The detection of the fatigue crack nucleation by the AE method for the ultrasonic resonant fatigue test was experimentally performed for the first time. The method obtained in the work can be used to stop the fatigue tests immediately before the development of the crack (C04).
- A method of cluster detection of non-metallic inclusions in steels and alloys was developed for metallographic inspection. The research is based on the fracture surfaces analysis after high-cycle fatigue testing and hierarchical agglomerative clustering of polished cross sections (C04).
- Casting of the Al alloy AlSi9Cu3 with different Fe contents and different morphology of the intermetallic phases. Characterization of the mechanical properties by fatigue tests (S03, C04, C06).
- Investigation of the relationship between plastic deformation and acoustic emissions in the steel 42CrMo4 and the cast iron GJS-400. It was shown that the ratio of the energy of the continuous acoustic emission during first plastic deformation of the steel and the volume of this plastic deformation is a characteristic value. This value was applied to identify the point of crack initiation during impact loading conditions (C05).
- This method was not applicable in the case of the cast iron. However, it was observed that the discontinuous acoustic emissions (bursts) are related to the cleavage fracture events (C05).
- The resistance to crack initiation and crack growth of the steel 42CrMo4 at low temperatures and very high loading rates was investigated with the help of the Split-Hopkinson pressure bar. A decrease in temperature resulted in a decrease of the crack initiation toughness and the blunting of the crack tip (C05).

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

- Impingement-test for filters made by using a novel eco-friendly binding system as preliminary investigations for third period (A01).
- Manufacturing of notched specimens by subproject A02 to determine the failure behavior with the help of experimental tests (C03).
- Realization of preliminary tests at testing set-up with possible testing-temperatures up to 1500 °C and improving the constructive set-up.
- Evaluation oft he deformation behavior of compact compression and bending specimens (B05, C02).
- Validation of the assumed foam creep law (B05) at high temperatures (1350 °C) using foam creep tests (C02) of real foam samples.
- High temperature compression tests with compact Al_2O_3-C realized (C02): compressive strength rises up to 1500 °C.
- Performing of first fracture mechanical experiments including partial unloading at a temperature of 1400 °C (C02).
- Determination of retained strength of CA6 and CA2 finger test specimens (C02).

MODELING OF THE HIGH-TEMPERATURE CREEP DEFORMATION BEHAVIOR OF AL_2O_3-C CERAMIC FOAMS

Author: Christoph Settgast
(Subproject B05)

Subproject B05 deals with the description of the temperature dependent material behavior of filter materials and filter structures.

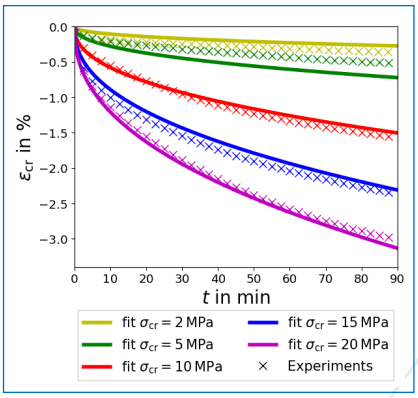


Fig. 1: Results of high-temperature creep test and material parameter optimization.

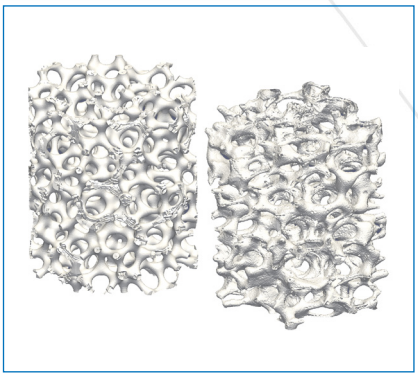


Fig. 2: Comparison on the artificial generated and a real foam structure.

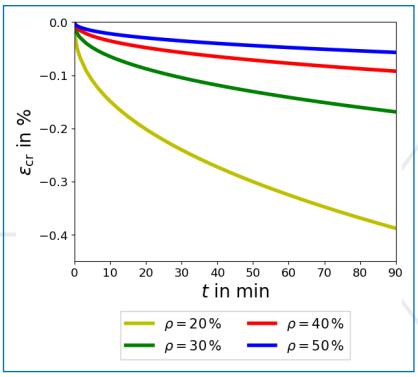


Fig. 3: Influence of the relative foam density on the creep deformation behaivor of the artificial generated foam structure (σ_{cr}^{foam} =0.1 MPa).

Ceramic foam filters for metallic melts are exposed to high temperatures. Therefore, it is important to know their high temperature material behavior and to be able to describe it. At temperatures above 1200 °C, a distinct creep deformation behavior of the compact carbon-bonded alumina was found [1]. Thus, this material deforms under constant load. A suitable mathematical description of this material property is needed in order to be able to investigate the creep deformation behavior of foam structures.

The creep deformation of the compact Al_2O_3-C was investigated using cylindrical samples with a diameter of d =25 mm and a height of h=25 mm. The samples were produced and tested within the subproject C02. They were tested with a constant uniaxial compressive stress σ_{cr} for a duration of t=90 min. The testing temperature was T=1350 °C . The creep strain curves for five different compressive stress levels are depicted in Figure 1. A dominating primary creep behavior with a variable creep strain rate was found, especially for high stresses.

In order to describe this behavior, the Norton-Bailey law was used. This law represents the creep strain rate $\dot{\varepsilon}$ as a function of the stress σ_{cr} and the time t: $\dot{\varepsilon} = (\sigma_{cr}/A)^n t^m$. By adapting the material parameters A, n and m, the high-temperature creep deformation behavior can be modeled. The result of the material parameter optimization is shown in Figure 1. A comparison of the experimental and simulated creep curves reveals quite good agreement. Only in the case of the curves for a stress of σ_{cr}=5 MPa there are comparatively large relative deviations. A more detailed discussion of the high-temperature compression creep test, the creep power law and the material parameter adaption can be found in [2].

The creep law just presented and adapted to real creep strain curves was used to predict the creep deformation behavior of an artificial created foam structure developed within in the subproject B05. This artificial foam structure is in a very good accordance with real ceramic foams considering the structural properties, as discussed in detail in [3] and shown in Figure 2. By using the local creep law together with the artificial foam structure, the influence of different geometrical factors on the foam creep deformation behavior can be investigated. Thus, statements about the high-temperature deformation behavior of real structures can be derived.

As an example, the influence of the relative foam density ρ on the foam creep behavior of the artificial generated structure is shown in Figure 3 for the same stress at the foam σ_{cr}^{foam} =0.1 MPa . The relative foam density represents the ratio of the volume of the material to the volume of the surrounding body. As the volume of the material increases, the structure becomes stiffer and thus the foam creep rate decreases. For this reason, less foam creep deformation occurs after the same time. Therefore, for a high creep resistance and dimensional stability of the loaded filter during a high temperature application, a high relative density is necessary. ■

[1] J. Solarek, C. Bachmann, Y. Klemm, C. G. Aneziris, H. Biermann, J. Am. Ceram. Soc. 2016, 99 (4), 1390-1397
[2] C. Settgast, J. Solarek, Y. Klemm, M. Abendroth, M. Kuna, H. Biermann, Adv. Eng. Mater. 2017, 19 (9), 1700082 (1-9)
[3] M. Abendroth, E. Werzner, C. Settgast, S. Ray, Adv. Eng. Mater. 2017, 19 (9), 1700080 (1-10)

MECHANICAL BEHAVIOR OF FINE-GRAINED, CARBON-BONDED FOAM STRUCTURES AT TEMPERATURES UP TO 1500 °C

Author: Johannes Solarek
(Subproject C02)

Subproject C02 deals with the mechanical properties of carbon-bonded filter materials at high temperatures. Besides testing the filter material in compact specimens, investigation of filter specimens is one main topic.

Carbon-bonded materials are widely used in refractory applications because of their unique chemical, physical, and mechanical properties at high temperatures. The mechanisms of their high-temperature deformation are, however, unclear.

In the present study, such filter structures were tested in quasi-static compression tests under Argon-atmosphere at temperature up to 1500 °C. Figure 1. shows the setup of the tests.

At intermediate temperatures of 800 °C to 1200 °C the filter specimens showed brittle behavior. The force-compression-curves, see Figure 2a, showed linear rise due to the elastic deformation of the filters. At various points, several distinct drops of force took place. These drops of force are the result of failure of single filter struts. At higher temperatures up to 1500 °C, less distinct drops were observed. Thus, nearly no struts broke during the tests. The filters showed more ductile behavior, which led to smooth and continuous force-compression-curves, see Figure 2b.

All tests were analyzed regarding the maximal force during the tests, to gain information about filter strength. The results are shown in Figure 3 as a function of testing temperature. Up to 1300 °C, filter strength remains nearly constant. At 1400 °C, a pronounced maximum can be found.

At 1500 °C filter strength drops again. The described maximum of strength can be explained due to change in material behavior from brittle to ductile at high temperatures. At intermediate temperatures, the filters have no ability for plastic deformation. The tested filters exhibit many notches and stress concentrations in their structure. When the filter is loaded, the force rises until the load at these stress concentrations exceeds the filter strength. The strut breaks and the force drops significantly. With further compression, other parts of the filter are loaded and the force rises again.

At 1400 °C the filters show more ductile behavior and stress concentrations are reduced through plastic deformation. The deformation of the strut leads to more homogeneous load distribution within the filter. Since the whole filter is loaded now, its strength increases. At 1500 °C further softening of the material leads to reduction of strength.

The ductile behavior of the filter was proven on filters tested at 1500 °C, which showed plastic deformation up to 2 mm. One specimen showed a partially cracked strut after testing at 1500 °C. This indicates stable crack growth and absence of brittle behavior, see Figure 4.■

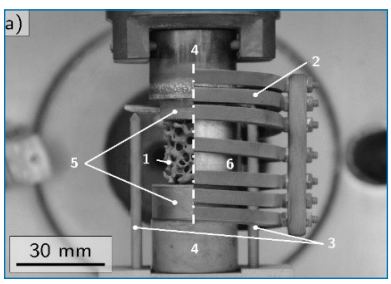


Fig. 1: Test setup for high-temperature compression tests: specimen (1), copper coil (2), extensometer rods (3), Si_3N_4-pistons (4), susceptors (5) and susceptor cage (6).

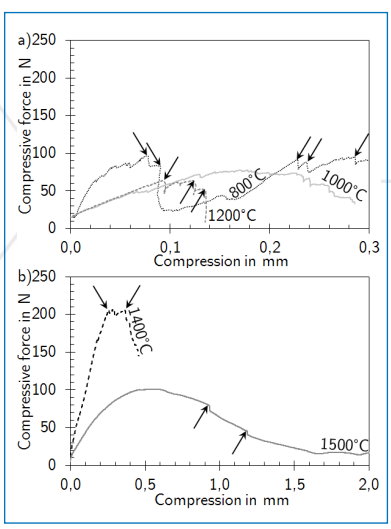


Fig. 2: Force-compression-curves of filter specimens at intermediate (a) and high (b) temperatures with brittle (a) and ductile (b) behavior. Arrows indicate brittle fracture of single filter struts.

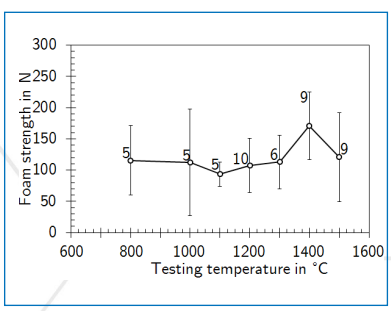


Fig. 3: Strength of filter specimens in dependency of temperature with pronounced maximum at 1400 °C.

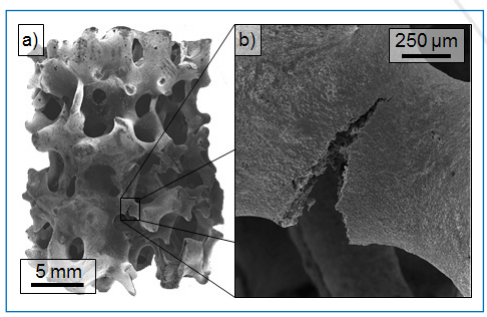


Fig. 4: Overview (a) and detailed image (b) of a filter tested at 1500 °C observed with SEM. (b) shows a partially cracked strut.

[1] J. Solarek, C. Himcinschi, Y. Klemm, C.G. Aneziris, H. Biermann, Carbon 2017, 122, 141-149

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CURRENT PUBLICATIONS (DECEMBER 2017 - MAY 2018)

Further information about the currently 240 publications from the second program period until May 2018 until as well as about the currently 17 patents and patent applications are available http://tu-freiberg.de/forschung/sfb920.

Project area A - Filter materials

Subproject A01

Bock, B., Schmidt, A., Schmidt, G., Jastrzebska, I., Szczerba, J., Aneziris, C.G. (2018): Spinel forming systems (Mg-/Fe-/Mn-Al-O) as coating material for carbon-bonded filters for steel melt filtration. 93. DKG Jahrestagung & Symposium Hochleistungskeramik 2018, 10.-13.04.2018, Messe München, Germany, Poster

Gehre, P., Schmidt, A., Dudczig, S., Hubálková, J., Aneziris, C.G., Child, N., Delaney, I., Rancoule, G., DeBastiani, D (2018): Interaction of slip- and flame-spray coated carbon-bonded alumina filters with steel melts. Journal of the American Ceramic Society, Vol. 101, Iss. 7, July 2018, pp. 3222-3233, DOI 10.1111/jace.15431.

Jankovský, O., Storti, E., Moritz, K., Luchini, B., Jiříčková, A., Aneziris, C.G. (2018): Nano-functionalization of carbon-bonded alumina using graphene oxide and MWCNTs. Journal of the European Ceramic Society, (2018), accepted: 30.04.2018, DOI 10.1016/j.jeurceramsoc.2018.04.068

Luchini, B., Hubálková, J., Wetzig, T., Grabenhorst, J., Fruhstorfer, J., Panfolfelli, V.C., Aneziris, C.G. (2018): Carbon-bonded alumina foam filters produced by centrifugation: A route towards improved homogeneity. Ceramics International, accepted: 26.04.2018, DOI 10.1016/j.ceramint.2018.04.228

Luz, A.P., Gabriel, A.H.G., Consoni, L.B., Aneziris, C.G., Pandolfelli, V.C. (2018): Self-reinforced high-alumina refractory castables. Ceramic International, Vol. 44, Iss. 2, 1 Februar 2018, pp. 2364-2375, DOI 10.1016/j.ceramint.2017.10.205

Storti, E., Berek, H., Aneziris, C.G. (2018): Focused ion beam preparation and microscopy investigation of secondary layer on carbon-bonded alumina filter after steel contact. Ceramics International, accepted: 09.05.2018, DOI 10.1016/j.ceramint.2018.05.065

Storti, E., Dudzig, S., Schmidt, G., Aneziris, C.G. (2018): Impact of surface functionalization of carbon-bonded filters on steel purity. 93. DKG Jahrestagung & Symposium Hochleistungskeramik 2018 ,10.-13.04.2018, Messe München, Germany, Vortrag

Storti, E., Jankovský, O., Colombo, P., Aneziris, C.G. (2018): Effect of heat treatment conditions on magnesium borate fibers prepared via electrospinning. Journal of the European Ceramic Society, (2018), Vol. 38, Iss. 11, (September 2018), pp. 4109-4117, DOI 10.1016/j.jeurceramsoc.2018.04.050

Storti, E., Schmidt, A., Dudczig, S., Aneziris, C. G. (2018): Surface functionalization of carbon-bonded filters and impact on steel cleanliness. Proceedings of the 60th International Colloquium on Refractories 2017 – Supplier Industries enabling REFRACTORIES, 18.-19.10.2017, Aachen, pp. 190-193, ISBN 978-3-9815813-3-1

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Subproject A02

Voigt, C., Aneziris, C.G. (2018): The influence of the measurement parameters on the crushing strength of reticulated ceramic foams. 93. DKG Jahrestagung & Symposium Hochleistungskeramik 2018 ,10.-13.04.2018, Messe München, Germany, Poster

Voigt, C., Ditscherlein, L., Werzner, E., Nowak, R., Peuker, U., Sobczak, N., Aneziris, C.G. (2018): Wettability of AlSi7Mg alloy on alumina, spinel, mullite and rutile and its influence on the aluminum melt filtration efficiency. Journal of Materials & Design, Vol. 150, 15 July 2018, pp. 75-85, DOI 10.1016/j.matdes.2018.04.026.

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Voigt, C., Hubálková, J., Anziris, C.G. (2018): Druckfestigkeitsmessungen an offenzelligen keramischen Schäumen ex situ und in situ CT Analysen. Interdisziplinäre Symposium für Ingenieurinnen und Naturwissenschaftlerinnen, ISINA 2018, Chemnitz, 5.-06.03.2018, Poster

Subproject A03

Ilatovskaia, M., Saenko, I., Savinykh, G., Fabrichnaya, O. (2018): Experimental study of phase equilibria in the Al_2O_3-MgO-TiO_2 system and thermodynamic assessment of the MgO-TiO_2 system. Journal of the American Ceramic Society, accepted: 27.04.2018, DOI 10.1111/jace.15748

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Subproject A05

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Subproject A07

Becker, H., Leineweber, A. (2018): Approximate icosahedral symmetry of α-Al(Fe,Mn,Cr)Si in electron backscatter diffraction analysis of a secondary Al-Si casting alloy. Materials Characterization, 141 (July 2018), pp. 406-411, DOI 10.1016/j.matchar.2018.05.013

Becker, H., Leineweber, A. (2018): Evaluation of the sample preparation quality for EBSD using SEMs with different EBSD detectors. DVM/DGM AK-Treffen „Mikrostrukturcharakterisierung im REM“, Univeristät Kassel, 28.-29.05.2018, Vortrag

Project area B - Modeling of flter structures/ flter systems

Subproject B01

Ditscherlein, L., Peuker, U.A. (2018): The influence of nanobubbles on the interaction forces between alumina particles and ceramic foam filters in water. 8th World Congress on Particle Technology - WCPT, Orlando, USA, 22.-26.04.2018, Vortrag

Ditscherlein, L., Knüpfer, P., Peuker, U.A. (2018): AFM measurements of adhesion force on hydrophobic surfaces. 8th World Congress on Particle Technology - WCPT, Orlando, USA, 22.-26.04.2018, Vortrag

Hoppach, D., Peuker, U.A. (2018): Principles of Particle separation in ceramic deep foam filters based on a water model. Filtech 2018, 13-15 March 2018, Köln, Vortrag P069

Hoppach, D., Peuker , U.A. (2018): Prinzipien der Partikelabscheidung in keramischen Tiefenfiltern basierend auf einem Wassermodell. ProcessNet Jahrestreffen, Merseburg, 26.-28.02.2018, Poster, MFA P06

Subproject B03

Vijay, D., Goetze, P., Wulf, R., Gross, U. (2018): Homogenized and pore-scale analyses of forced convection through open cell foams. International Journal of Heat and Mass Transfer, Vol. 123, August 2018, pp. 787-804, DOI 10.1016/j.ijheatmasstransfer.2018.03.008

Subproject B04

Knüpfer, P., Peuker, U.A. (2018): Heterokoagulation von hydrophoben Partikeln durch Mikro/Nanoblasen. ProcessNet Jahrestreffen, Merseburg, 26.-28.02.2018, Plenarvortrag, Nr. 12362

Knüpfer, P., Peuker, U.A. (2018): Interaction Forces in Relation to Agglomerate Size of Hydrophobic Particles. 8th World Congress on Particle Technology - WCPT, Orlando, USA, 22.-26.04.2018, Vortrag

Subproject B06

Asad, A., Bauer, K., Chattopadhaya, K., Schwarze, R. (2018): Numerical and experimental modeling of the recirculating melt flow inside an induction crucible furnace. Metallurgical and Materials Transactions B, Vol. 49, Iss. 3, pp. 1378-1387, DOI 10.1007/s11663-018-1200-4

Project area C - Filter efficiency and material properties

Subproject C01

Fruhstorfer, J., Dudczig, S., Rudolph, M., Schmidt, G., Brachhold, N., Schöttler, L., Rafaja, D., Aneziris, C.G. (2018): Interface analyses between a case-hardened ingot casting steel and carbon-containing and carbon-free refractories. Metallurgical and Materials Transaction B, Vol. 49, Iss.3, June 2018, pp. 1499-1521, DOI 10.1007/s11663-018-1216-9

Luchini, B., Grabenhorst, J., Fruhstorfer, J., Pandolfelli, V.C., Aneziris, C.G. (2018): On the nonlinear behavior of carbon-bonded alumina at high temperatures. 93. DKG Jahrestagung & Symposium Hochleistungskeramik 2018 ,10.-13.04.2018, Messe München, Germany, Poster, Best Poster Award, 3. Platz

Luchini, B., Grabenhorst, J., Fruhstorfer, J., Pandolfelli, V.C., Aneziris, C.G. (2018): On the nonlinear behavior of Young's modulus of carbon-bonded alumina at high temperatures. Journal of the American Ceramic Society, accepted: 25.03.2018, pp.1-13, DOI 10.1111/jace.15575

Subproject C03

Zielke, H., Abendroth, M., Kuna, M., Kiefer, B. (2018): Determining the fracture toughness of ceramic filter materials using the miniaturized Chevron-notched beam method at high temperature. Ceramics International, (2018), accepted: 28.04.2018, DOI 10.1016/j.ceramint.2018.04.248

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Subproject C04

Gleinig, J., Lippmann, A., Weidner, A., Biermann, H. (2018): Microstructural analysis of non-metallic inclusions in cyclically deformed 18CrNiMo7-6 treated with different crucible materials. Proceedings of the 60th International Colloquium on Refractories 2017 – Supplier Industries enabling REFRACTORIES, 18.-19.10.2017, Aachen, pp. 199, ISBN 978-3-9815813-3-1

Transfer projects

Transfer project T01

Wetzig, T., Solarek, J., Klemm, Y., Hubálková, J., Aneziris, C.G., Biermann, H. (2018): Mechanical Properties of Fine-Grained Carbon-Bonded Refractory Foams at Temperatures up to 1400 °C, a Tool for Predicting the Form Stability Behavior of Large Filter Components. Proceedings of the 60th International Colloquium on Refractories 2017 – Supplier Industries enabling REFRACTORIES, 18.-19.10.2017, Aachen, pp. 200-203, ISBN 978-3-9815813-3-1

Wetzig, T., Solarek, J., Klemm, Y., Hubálková, J., Biermann, H., Aneziris, C.G. (2018): Mechanical strength, fracture and deformation behavior of carbon-bonded alumina foams at temperatures up to 1500 °C as well as during steel casting. 93. DKG Jahrestagung & Symposium Hochleistungskeramik 2018 ,10.-13.04.2018, Messe München, Germany, Vortrag

Complementary projects

Aneziris, C.G. (2018): Clean Steel - Technologien auf der Basis von Wechselwirkungen von funktionalisierten Filtersystemen mit Stahlschmelzen. Plenarvortrag aus der Technikwissenschaftlichen Klasse, Sächsische Akademie der Wissenschaften, 04.05.2018, Leipzig, Plenarvorträge 2018

Fischer, U., Dudczig, S., Aneziris, C.G. (2017): Intelligente Funktionshohlräume: Keramische Filter für die Metallschmelzefiltration; ein Beitrag zu Zero Defect Materials. Acamonta, 24 (2017), TU Bergakademie Freiberg, S. 33-37.

Patents and patent applications

Subproject A01

Verfahren zur Herstellung von porösen oder dichten keramischen, metallischen oder metallokeramischen komplexen Erzeugnissen mit verbesserten thermomechanischen Eigenschaften. PCT - Patentanmeldung Nr. PCT/EP2018/051864, Anmeldetag: 25.01.2018

Keramische Metallschmelze-Filter. Patentanmeldung 10 2018 201 577.5, Anmeldetag: 05.02.2018

Subproject C02

Verfahren zur Herstellung von Bauteilen mit lokal definierter unterschiedlicher physikalischer Dichte und/oder Porosität. Patentanmeldung Nr. 10 2016 212 474.9, Anmeldetag: 08.07.2016, Offenlegungstag: 11.01.2018

PRIZES

Honoring his outstanding dissertation on „Adhesion between technical rough surfaces“ **Dr.-Ing. Jörg Fritzsche** received the **„Bernhard-von-Cotta“ award**. Dr.-Ing. Fritzsche is a former employee of the TU Bergakademie Freiberg in the subproject B04. The prize was awarded by the association of friends and supporters of the TU Bergakademie Freiberg during its general meeting in December 2017.

Photo (from left to right): Dr. Jörg Fritzsche, Prof. Dr. Gerhard Roewer, Prof. Dr. Horst Brezinski, Prof. Dr. Jörg Schneider, M.Sc. Steffen Trümper, Prof. Dr. Olena Volkova, Dipl.-Ing. Matthias Groll, Prof. Dr. Gottfried Jäckel.

AWARDS AND DISSERTATIONS

Again two doctoral students of the CRC‘s research training group defended successfully their dissertations. **M.Sc. Lilit Amirkhanyan** received her PhD for her work on „Thermodynamic properties of intermetallics: Surfaces and Interfaces“.

Herr M.Sc. Enrico Storti finished successfully his dissertation on „Functionalization of carbon-bonded ceramic foam filters with nano-scaled materials for steel melt filtration“.

Photo (from left to right): Prof. H. Biermann, Prof. P. Colombo, Prof. C.G. Aneziris, Dr. E. Storti, Prof. R. Schwarze.

GUESTS FROM INDUSTRY

On December 12th last year CRC 920 member had the chase to join a workshop with Foseco International Ltd. from the UK. The workshop‘s topic was „Metal Melt Filtration for Foundry/Steel product & application“.

Photo : Nick Child, representative of Foseco International Ltd., at his speech during the workshop in Freiberg.

CONFERENCES AND CALLS FOR PAPERS

CIMTEC 2018 - 14th International Conference on Modern Materials and Technologies: 04.-08.06.2018 in Perugia, Italy; further information at http://2018.cimtec-congress.org.

ICC 2018 - 7th International Congress on Ceramics: 7.-21.06.2018 in Foz do Iguaçú, Brazil; further information at http://www.icc7.com.br.

WFC 2018 - 73. World Foundy Congress, Session CRC 920: 23.-27.09.2018 in Krakau, Poland; further information at http://www.73wfc.com/

61. International Refractory Colloquium: 26.-27.09.2018 in Aachen; further information at: http://www.ecref.eu/index.php?id=kolloquium&L=1

MSE 2018 - Material Sience Engineering Congress: 24.-28.09.2018 in Darmstadt; further information at https://www.mse-congress.de/home/

CellMAT 2018 - 5. Cellular Materials, Session CRC 920: 24.-26.10.2018 in Bad Staffelstein; further information at https://cellmat2018.dgm.de/home/

9. Freiberger Refractory Forum: 12.12.2018 in Freiberg.

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PHOTOS
TU Bergakademie Freiberg, SFB 920 „Multifunktionale Filter für die Metallschmelzefiltration - ein Beitrag zu Zero Defect Materials“,
Detlev Müller;
avecfilm Film- & Medienproduktion

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