SFB 920

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

NEWSLETTER 8 (1/2015)

DFG Deutsche Forschungsgemeinschaft

TECHNISCHE UNIVERSITÄT BERGAKADEMIE FREIBERG
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DEAR READERS,

The Collaborative Researech Center CRC 920 “Multi-Functional Filters for Metal Melt Filtration - A Contribution towards Zero Defect Materials“ has started its second program period: Based on excellent evaluations of research results obtained during the first program period the German Research Foundation DFG approved the second funding period until 2019.

The highly committed team of researchers, post-docs and doctoral students has set new objects: During the next four years research will focus on functional coatings which enhance multifiltration of several inclusions.

Details on these and other activities 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,

CONTENT

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

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

EXCELLENT EVALUATIONS PERMIT STARTING THE SECOND PROGRAM PERIOD

The German Research Foundation DFG has approved the second program period of the CRC 920 "Multi-Functional Filters for Metal Melt Filtration - A Contribution towards Zero Defect Materials". Until 2019 a team of 22 researchers from 11 institutes and four faculties of the TU Bergakademie Freiberg will be jointly investigating the targeted multifiltration of nonmetallic inclusions with varying chemical properties and crystal systems from metallic melts.

For four years, a highly committed team of researchers and doctoral students of the TU Bergakademie Freiberg has investigated excellent functional and mechanical materials properties adjusted to specific loadings of components and modules that enable ground-breaking innovations for security and light-weight constructions. As a result, the team produced more than 140 journal articles and conference papers inlcuding 85 publications in peer-reviewed journals. 70 % of all publications are joint works that benefit from interdisciplinary author teams, representing different subprojects. For more than 80 % of all publications, doctoral students have served as first authors. In 2014, in the project area "Filter materials" already three patents have been granted .

In February 2015, the German Research Foundation DFG assessed existing research results and planned activities as "very good" or "excellent". Based on these results, on May 21st 2015 the DFG Grants Commitee on Collaborative Research Centers approved the second funding period for the CRC 920 and the provision of approx. 9.5 mill. Euros.

The CRC 920 aims at a significant reduction of anorganic inclusions in metal melts by employing smart filter materials and filter systems. "Our research answers the call from the industry for higher levels of purity and lower reject rates. The novel filter systems are able to significantly reduce unfavorable anorganic nonmetallic inclusions in the metal matrix. Therefore, mechanical properties of metallic components improve, which, in turn, contributes to an effective recycling of metallic materials," says Prof. Christos G. Aneziris, Coordinator of the CRC 920.

The development of novel filter materials as well as a computer-aided micro- and macrostructure filter design based on investigations of relevant filtration mechanisms will permit both thin- and thick-walled high-strength components made from steel, iron, aluminum and magnesium, with superior properties, such as strength, ductility, and fatigue resistance, that enhance passenger safety in cars, trains, and aircrafts. In addition, novel avenues for application are opened, including the filtration of copper and silicon in the electronic industry, the production of thin aluminum foils for the packaging industry, as well as with regard to filtration technology and slag conditioning. Hence, higher material efficiency, the reduction of energy and CO_2-emissions is coming within reach. To this end, researchers, post-docs and doctoral students from various disciplines including materials science, modeling, processing, testing and visualization work closely together.

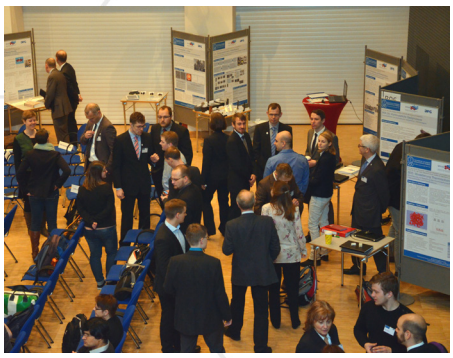


Photo: Researchers and doctoral students presented their projects and results to the experts of the German Research Foundation DFG.

Throughout the next four years, research will be focusing on functional coatings for a multifiltration of different inclusions. The CRC team aims at reducing the inclusions immediately after their genesis, using metastable phases within functional coatings. ■

MORE NEWS

5th FREIBERG REFRACTORY FORUM

The CRC 920, the Priority Program 1418 “FIRE“ as well as the DGM/DKG Technical Committee “Refractory Materials“ and the VDEh jointly invited to the **Freiberg Refractory Forum** for the fifth time. More than 100 guests from 14 countries attended the conference.

The conference was committed to economic developments and current research trends of refractories in emerging countries, specifically in India. After China and Japan, India is regarded as the third-largest consumer of refractory materials and components. Albeit a currently modest development, the expected growth of the Indian steel industry will be leading to a considerable increase in the demand for refractory solutions. Products and services that enhance the purity of metal melts will be of particular importance.

The program included, among others, presentations from **Anirban Dasgupta (Executive Director of the Indian Refractory Makers Association) and Dr. Arup Ghosh (CSIR-Central Glass & Ceramic Research Institute, Indien)**. ■

Photo (from left to right): Dr. C. Wöhrmeyer, Prof. Dr. H. Jansen, Prof. Dr. T. Bier, Prof. Dr. C. G. Aneziris, Prof. Dr. P. Quirmbach, Dr. P. Gehre

INTERNATIONAL AWARD

The 4th IEEE Symposium on Large Data Analysis and Visualization (LDAV), held in Paris, has awarded the research results obtained in the CRC 920 on mechanisms and potential improvement of data compression methods. The paper submitted by **Henry Lehmann and Prof. Bernhard Jung** received a Best Paper Honorable Mention.

The authors, invoveld with the simulation and visualization of filtration processes, explore new approaches for so-called in situ data compression methods. Such methods are able to reduce the amount of data already during simulation and therefore facilitate almost lossless loading and visualization of large data sets.

Henry Lehmann and Bernhard Jung have created approaches which permit reducing the amount of data to be stored. Further they suggest storing the data in a hierarchical format. Both approaches aid a faster storage and visualization of large data sets, even at higher resolution levels. ■

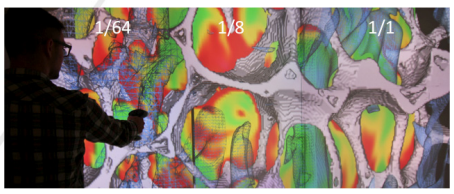


Photo.: Interactive visualization of a simulated filtration process in the CAVE at several levels of resolution.

OCCUPATIONAL RISKS IN INDUSTRY

A guest seminar for doctoral students, post-docs and members of the CRC 920 shed light on the identification and assessment of occupational risks in industry. The seminar was held by **Dr. Olga Aneziris** from the Institute of Nuclear Technology - Radiation Protection, Sector of Industrial Risk des N.C.S.R. “DEMOKRITOS“ Athens, Greece, who had been invited to TU Bergakademie Freiberg as a visiting scholar.

Taking the example of the aluminum industry, Dr. Aneziris illustrated methods and processes for identifying and quantifying occupational risks at different job positions and workplaces. Based on such analyses, risk profiles can be ranked and appropriate security measures can be determined.

The aluminum industry is of specific relevance for the CRC 920: The production of aluminum components, for instance for vehicles and aircrafts, would strongly benefit from an effective metal melt filtration which is able to enhance quality, to reduce reject rates and to decrease costs for energy, materials, shaping and labor. ■

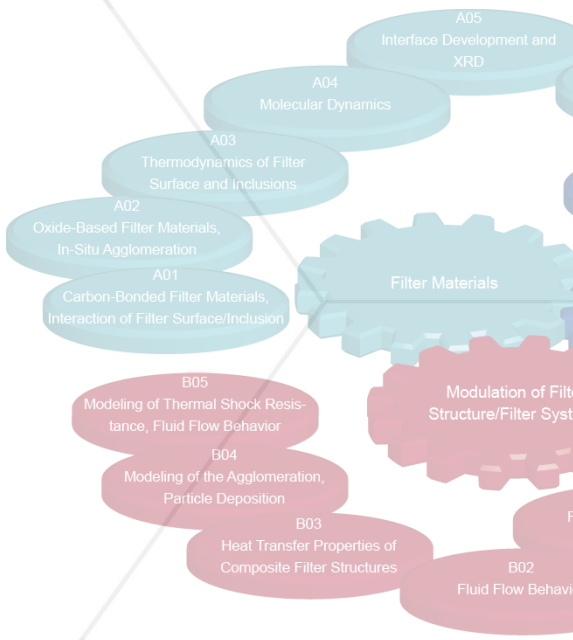
Photo (from left to right): Dr. Undine Fischer, Dr. Olga Aneziris, Prof. Dr. Christos G. Aneziris

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.

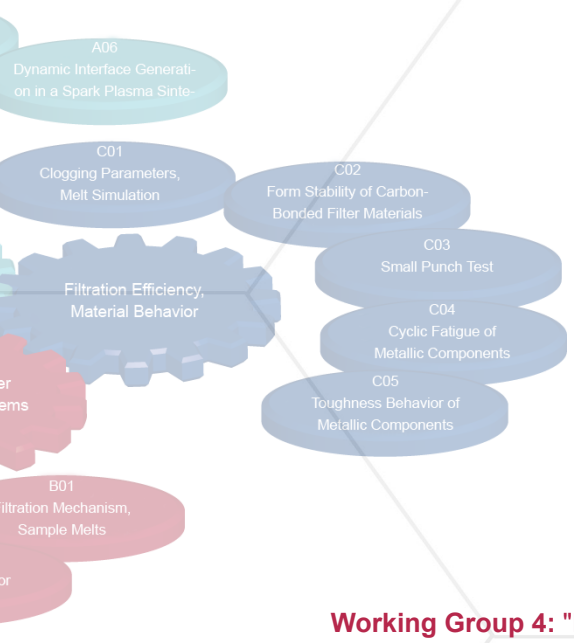
Working Group 1: "Metal melt/inclusions, active/reactive filter materials, boundary surface design" (Coordination: Dipl.-Ing. Tilo Zienert)

- Beginning of the development of gradient Al_2O_3-/$MgAl_2O_4$-C filters (A01),
- Investigation of the influence of the composition of the additives on coating properties of the foams using the centrifuge (A02),
- Fabrication of foam ceramic filters with a metastable alumina coating due to coatings based on alumina hydroxides (A02, A06),
- Investigation of the decomposition reaction of different alumina hydroxides using Differential Thermoanalysis (A03),
- Test of Al_2O_3-C filters with and without carbon nanotubes employing the casting simulator (Ph.D. student Enrico Storti),
- First trials to produce fibers directly on alumina-carbon filters using electro-spinning, conducted at the University of Padova (Ph.D. student Enrico Storti),
- Investigation of surface reaction of the liquid AlSi7Mg-alloy with spodumen-containing substrate using sessile-drop measurements (C06N),
- Start of a diploma thesis focusing on the investigation of the influence of the substrate quality on sessile-drop measurements and the measured contact angles (C06N, in advance),
- Detection of the formation of γ-Al_2O_3 during short-time contact of aluminium melt with amorphous SiO_2 using heat-treatment of sintered tablets, SPS-melting and a combination of electron microscopy with WDX/EDX and XRD (A06).



Working Group 3: "Thermo-mechanical characteristics of filter materials and structures" (Coordination: Dipl.-Wi.-Ing. Yvonne Klemm)

- Numerical simulation of the effective thermal and mechanical properties as a function of the geometric parameters of the filter, calculation of failure interfaces in the stress space for predicting possible filter damage during casting, to produce filters with improved thermomechanical properties (B05),
- Implementation of the inductive heating of Al_2O_3-C ceramic foam filters and compression tests on Al_2O_3-C foam filter structures first at room temperature, bending tests up to 1,500 °C on samples with alignment longitudinal/transversal to the pressing direction, optimization of strain measurement in compression tests to eliminate measurement of the thermal expansion of the susceptors (C02),
- Experimental determination of temperature-dependent strength and fracture toughness at small samples, small punch tests and miniaturized pressure tests for the determination of strength asymmetry in tension and compression, relaxation tests to describe the time-dependent deformation of the filter ceramics at high temperatures (C03).



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

- Development and implementation of an Euler-model for the prediction of filtration on the basis of statistical moments of the liquid melt flow and comparison to a detailed particle tracking on the unsteady flow field (B02, B04),
- Model development for the description of adhesion forces and their distributions on rough surfaces for the case of capillary bridges resulting from gas bubbles as well as van der Waals or hydrophobic interactions (B04),
- Investigation of the effect of the viscous force, which acts on inclusions approaching the filter wall due to the displacement of liquid metal (B01, B02),
- Development and improvement of a numerical method for the modeling and simulation of isotropic turbulence on the basis of multi-dimensional Gaussian processes (B04),
- Visualization of the penetration of ceramic filters and measurement of their permeability using a model fluid and adapted wetting angle (B03),
- Generation of artificial filter structures on the basis of Kelvin cells, matching the geometric properties of a ceramic foam, and evaluation of agreement using effective properties (B02, B03, B05),
- Calculation of failure interfaces in stress space for the prediction of possible filter damage during casting operation (B05).

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

- Operation of a Photron FASTCAM SA-Z high-speed camera at the Institute of Materials Technology suitable for investigations with a temporal and local resolution of displacements and deformation localizations of up to 2.1 MFrames/s at various test facilities (e.g., drop impact tester, Split-Hopkinson Pressure Bar) (C05),
- Analysis and documentation of industrial casting tests using AlSi7Mg in cooperation with the Constellium Corporation, France (S03, A02),
- Usage of the Liquid Metal Cleanliness Analyzer (LiMCA) method for in situ detection of inlusions in aluminum melt (S01),
- Combination of high-resultion CT analyses, thermographic in situ methods, and fatigue tests in order to precisely identify internal defect locations in AlSi7Mg (C04, S01).

INFLUENCE OF NON-METALLIC INCLUSIONS ON FATIGUE BEHAVIOR

Author: Dr.-Ing. Dominik Krewerth
(Subproject C04)

Subproject C04 is focusing on the impact of filter properties on the quality of cast material in terms of the materials fatigue behavior. Fatigue testing at cyclic loading conditions identifies non-metallic inclusions with critical influence on materials failure. Findings provide insights into relevant criteria for an optimization of filter properties.

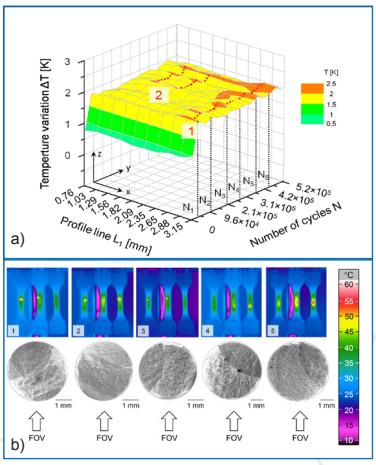


Fig. 1: Two-dimensional (a) and three-dimensional (b) in situ thermography measurements of cast steel G42CrMo4 (QT).
a) Internal fatigue crack initiation determined by the enhanced two-dimensional raster-evaluation procedure and b) precise determination of the point of crack initiation by three-dimensional thermography measurements for five selected fatigue specimens.

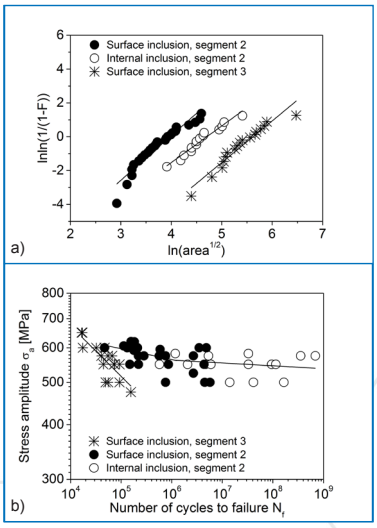


Fig. 2a: Weibull probability plot of the crack initiating non-metallic inclusions distinguished by the sampling position (segment 2 and segment 3) and the location of the non-metallic inclusions.
Fig. 2b) Stress vs. number of cycles to failure (SN)-plot for the varying sampling locations and crack initiation points.

Subproject C04 investigates the influence of non-metallic inclusions on the fatigue behavior of cast aluminium alloy AlSi7Mg (T6) and cast steel G42CrMo4 (QT) at high cycle fatigue (HCF) and very high cycle fatigue (VHCF) loading conditions. Ultrasonic fatigue testing under symmetric push-pull and tension-on-tension loading conditions is employed in combination with detailed fractographic investigations using scanning electron microscopy (SEM). The SEM in combination with EDX was used for the detection and the classification of the crack initiating non-metallic inclusions with regard to their size, location, chemical composition and morphology.

The second scope was the application of new in situ methods during ultrasonic fatigue testing (thermography, analysis of the resonant frequency and the nonlinearity parameter). These methods focus on the determination of the temporal and local crack initiation and damage accumulation. The different methods were combined, correlated to fractographic investigations (Fig. 1a) and three-dimensional extended (Fig. 1b). Thus, besides the definition of the time of crack initiation the precise determination of the point of crack initiation within the cylindrical fatigue specimens was achieved by the complementary techniques. The results obtained from ultrasonic fatigue testing and the defect sizes determined by fractographic investigations of the fatigue fracture surfaces were evaluated using a Weibull probability plot (Fig. 2a) and compared to the experimental lifetimes (Fig. 2b). A significant distinction between two segments of the casting plate (casting plate (segment 2) and the region below the raiser (segment 3)) was determined in terms of defect sizes and lifetimes. Furthermore, different crack initiation points are well distinguished in both diagrams (e.g. internal fatigue crack initiation from non-metallic inclusions and fatigue crack initiation from non-metallic inclusions at the surface). However, the scatter of the fatigue life in the casting plates of the present steel G42CrMo4 (QT) covers almost five decades, see Fig. 2b.

The application of the √area-model enables the clear characterization of the influence of the defect size in terms of fatigue life N_f. Moreover, the scatter is reduced significantly in the high cycle fatigue regime ($5 \times 10^4 < N_f < 10^7$) or in terms of fatigue crack initiation from non-metallic inclusion at the surface, respectively. However, in case of very high cycle fatigue loading conditions ($N_f > 10^7$) and internal fatigue crack initiation points the scatter persists even after the application of the √area-model (see Fig. 3a - open symbols). The large scatter of fatigue life caused by internal crack initiation was attributed to different crack initiation types. These internal crack initiation types are well identified by plotting the radii of the “fisheyes” as a function of the fatigue life N_f, compare Fig. 3b. Likewise, these crack initiation types are described by power laws. Consequently, the scatter of the fatigue life in the very high cycle fatigue is caused by different crack initiation types and is not exclusively limited to different sizes and locations of internal defects. ■

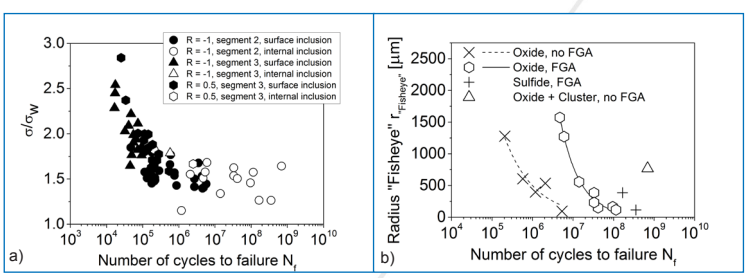


Fig. 3a: √area-model applied to the fatigue specimens. Every specimen failed due to non-metallic inclusions. Open symbols represent internal fatigue crack initiation points whereas filled symbols define crack initiating non-metallic inclusions directly at or in touch with the surface. b) Radii of the „fisheyes“ of the different crack initiation types as a function of the fatigue life N_f.

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NUMERICAL MODELING OF FILTRATION INSIDE CERAMIC FILTER STRUCTURES

CFD simulations of the filtration process can contribute to the identification of those filter properties and process conditions, which lead to an increased deposition of impurities. Within CRC 920, a comprehensive and detailed model is developed for the investigation of all contributing phenomena and their mutual interactions.

Author: Dipl.-Ing. Eric Werzner
(Subprojects B02, S02)

A prerequisite for the simulation of the filtration process are representative geometric models of the filter structures. For this purpose, different approaches are employed in the CRC 920: besides the reconstruction of filter foams from CT scan images it is possible to generate artificial idealised or random foam structures, whose geometrical properties can be controlled. In addition, the use of periodic structures, e.g. the Kelvin cell, renders a significant reduction of computational effort or allows the investigation of small scale flow structures.

The modeling of the flow of molten metal is based on the numerical solution of the Navier-Stokes equations by means of the lattice Boltzmann method (LBM). In this mesoscopic technique, quantities like pressure and momentum are given by the moments of discrete particle distribution functions describing the fluid. Due to its local character, LBM can be efficiently parallelised. Furthermore, the grid generation in computational domains of complex geometry is straightforward as voxel grids are used for the spatial discretisation.

Inclusions are modeled as discrete particles and are tracked by solving the equation of motion considering drag and buoyancy forces in the unsteady flow field. The modeling of particle deposition is subject to the assumption of short-range attractive forces which are sufficiently strong to prevent resuspension. Apart from the determination of filtration efficiency, the particle code is also employed for the prediction of effective properties of filter structures, e.g. the hydrodynamic dispersion.

A hybrid method coupling LBM with the finite volume method (FVM) is employed for the computation of the temperature field. The overall model was implemented in a computer code employing the MPI protocol for distribution of tasks on high performance computers. In order to store and visualise the bulk of data arising from high resolution simulations efficiently, the solutions are compressed in-situ, i.e. in the course of the simulation, to approximately one fifth of their original size.

The parameters of an exemplary simulation presented here are compiled in Table 1. Figure 1 shows the distribution of inclusions of 100 µm size in an enlarged section of the ceramic foam, through which the melt passes from the top to the bottom. Deposited inclusions are predominantly found on the upstream facing walls of the filter struts. The deposition distribution along the filter depth (Fig. 2) shows a typical trend for depth filtration corresponding to an exponential law. The strong dependence of filtration on the inclusion size can be clearly identified. While large inclusions are trapped due to their inertia as well as by direct interception, smaller particles follow the flow almost without any slip and are significantly less likely to be deposited. Moreover, the influence of inclusion density, flow velocity and gravity could be demonstrated in further investigations. ■

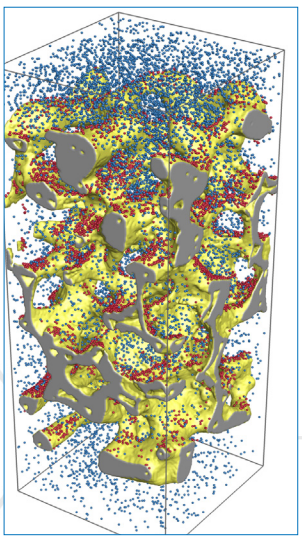

Figure 1:Deposition of inclusions in a perfused ceramic foam filter (10 ppi). Deposited particles are represented in red; a fictitiously high particle density was chosen to accelerate convergence of statistical quantities.

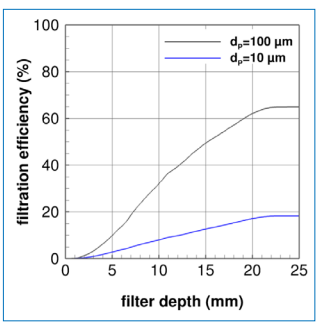

Figure 2: Variation of cumulative filtration efficiency with filter depth for inclusions of different size.

Inclusions		*Foam filter*	
Material	Al_2O_3	Pore density	10 ppi
Density	3,900 kg/m³	Porosity	86.2 %
Diameter	10 µm, 100 µm	Dimensions	40 x 40 x 20 (mm)³
Steel melt		*Numerical details*	
Inflow velocity / Flow rate	3.9 cm/s	Spatial resolution	65.0 µm
Inflow temperature	1,600 °C	Temporal resolution	23.5 µs
Density	6,977 kg/m³	Number of nodes	540 million
Dynamic viscosity	5,023 mPa·s	Number of particles	10 million

Table 1: Overview of simulation parameters for a steel melt filtration.

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TU BERGAKADEMIE FREIBERG

RECENT PUBLICATIONS

Project area A - Filter materials

Subproject A01

Emmel. M., Aneziris, C. G. (2015): Implementation of Novel Carbon Bonded Filter Materials for Steel Melt filtration – an Overview. refractories worldforum, Vol. 7, Iss. 1, pp. 73-82.

Storti, E., Emmel, M., Dudczig, S., Colombo, P., Aneziris, C. G. (2015): Development of multi-walled carbon nanotubes-based coatings on carbon-bonded alumina filters for steel melt filtration. Journal of European Ceramic Society, Vol. 35, Iss. 5, pp. 1569-1580, DOI 10.1016/j.jeurceramsoc.2014.11.026.

Moritz, K., Aneziris, C. G. (2015): Electrophoretic method for fabricating porous materials – application to different oxide materials. 5th International Conference on Electrophoretic Deposition: Fundamentals and Applications, Hernstein (Austria), Key Engineering Materials, Vol. 654, pp. 101-105, DOI 10.4028/www.scientific.net/KEM.654.101.

Subproject A02

Sarkar, N., Park, J. G., Mazumder, S., Pokhrel, A., Aneziris, C. G., Kim, I. J. (2015): Al_2TiO_5–mullite porous ceramics from particle stabilized wet foam. Ceramics International, Vol. 41 Iss. 4, Part A, pp. 6306-6311, DOI 10.1016/j.ceramint.2015.01.056.

Sarkar, N., Park, J. G., Mazumder, S., Pokhrel, A., Aneziris, C. G., Kim, I. J. (2015): Effect of Amphiphile Chain Length on Wet Foam Stability of Porous Ceramics. Ceramics International, Vol 41 Iss. 3 Part A, pp. 4021-4027, DOI 10.1016/j.ceramint.2014.11.089.

Voigt, C., Aneziris, C. G., Hubálková, J. (2015): Rheological characterization of slurries for the preparation alumina foams via replica technique. Journal of the American Ceramic Society, manuscript ID:JACERS-35459.R2, Vol. 98, Iss. 5, pp. 1460-1463, DOI 10.1111/jace.13522.

Voigt, C., Fankhänel, B., Jäckel, E., Aneziris, C. G., Stelter, M., Hubálková, J. (2015): Effect of the filter surface chemistry on the filtration of aluminum. Metallurgical and Materials Transactions B, Vol. 46, Iss. 2, pp. 1066-1072, DOI 10.1007/s11663-014-0232-7.

Subproject A03

Zienert, T., Dudczig, S., Fabrichnaya, O., Aneziris, C. G. (2015): Interface reactions between liquid iron and alumina-carbon refractory filter materials. Ceramics International, Vol. 41, Iss. 2, Part A, pp. 2089-2098, DOI 10.1016/j.ceramint.2014.10.004.

Zienert, T., Fabrichnaya, O. (2015): Interface reactions between steel 42CrMo4 and mullite. Journal of the European Cermic Society, Vol. 35, Iss. 4, pp. 795-802, DOI 10.1016/j.jeurceramsoc.2014.10.033.

Subproject A04

Amirkhanyan, L., Weissbach, T., Kortus, J. (2015): Surface energy, structure and stability of crystalline corundum surfaces. Verhandlungen der Deutschen Physikalischen Gesellschaft e.V. - DPG, March 15-20, 2015, Berlin.

Subproject A05

Dopita, M., Emmel, M., Salomon, A., Rudolph, M., Metej, Z., Aneziris, C. G., Rafaja, D. (2015): Temperature evolution of microstructure of turbostratic high melting coal-tar synthetic pitch studied using wide-angle X-ray scattering method. Carbon, Vol. 81, pp. 272-283, DOI 10.1016/j.carbon.2014.09.058.

Dopita, M., Salomon, A., Emmel, M., Aneziris, C. G., Rafaja, D. (2014): Microstructure evolution of turbostratic carbon studied by different analytical methods. Materials Structure, Vol. 21, Iss. 2, pp. 103-104, Struktura 2014.

Subproject A06

Salomon, A., Emmel, M., Dopita, M., Dudczig, S., Aneziris, C. G., Rafaja, D. (2015): Reaction mechanism between the carbon bonded magnesia coatings deposited on carbon bonded alumina and a steel melt. Journal of the European Ceramic Society, Vol. 35, Iss. 2, pp. 795-802. DOI 10.1016/j.jeurceramsoc.2014.09.033.

Salomon, A., Voigt, C., Dopita, M., Aneziris, C. G., Rafaja, D. (2014): Application of SPS/FAST for the generation of metal melt/ceramic interfaces and infiltration. International Conference on Sintering 2014, 24.-28.08.2014 Dresden. In: Proceedings of Sintering 2014, Poster Presentation, Chemical Interactions, CI_02, p. 221.

Project area B - Modeling of filter structures/ filter systems

Subproject B01

Heuzeroth, F., Fritzsche, J., Peuker, U. A. (2014): Wetting and its influence on the filtration ability of ceramic foam filters. Particuology, Vol. 18, pp. 50-57. DOI 10.1016/j.partic.2014.06.001.

Heuzeroth, F., Fritzsche, J., Werzner, E., Mendes, M. A. A., Peuker, U.A., Ray, S., Trimis, D.: Viscous force - An important parameter for the modelling of deep bed filtration in liquid media. Powder Technology, DOI 10.1016/j.powtec.2015.05.018

Subproject B02

Werzner, E., Laurinat, M., Herrmann, A., Ray, S., Trimis, D. (2014): Performance of Synthetic Geometries for Computationally Efficient Modelling of Flow Through Highly Porous Open-Cell Foams. International Conference on Numerical and Mathematical Modeling of Flow and Transport in Porous Media - NM2 Porous Media, 29 Sep - 3 Oct, 2014, Dubrovnik, Croatia.

Subproject B03

Götze, P., Vijay, D., Jäckel, E., Wulf, R., Gross, U. (2014): Experimental Determination of Convective Heat Transfer Coefficients During Molten Aluminum Purification Using Open-Cell Alumina (Al_2O_3) Ceramics. In: International Heat Transfer Conference 15 (2014), IHTC-15, August 10-15, 2014, Kyoto, Japan, ed.: A. Bar-Cohen, N. Kasagi and H. Yoshida, ISBN 978-1-56700-421-2, IHTC 15-9167, DOI 10.1615/IHTC15.fcv.009167.

Subproject B04

Fritzsche, J., Peuker, U. A. (2015): Wetting and adhesive forces on rough surfaces - An experimental and theoretical study. In: The 7th World Congress on Particle Technology (WCPT7), Beijing, China. Procedia Engineering, Vol. 102, pp. 45-53, DOI 10.1016/j.proeng.2015.01.105.

Saboor Bagherzadeh, E., Dopita, M., Mütze, T., Peuker, U. A. (2015): Morphological and structural studies on Al reinforced by Al_2O_3 via mechanical alloying. Journal of Advance Powder Technology, Vol. 26, Iss. 2, pp. 487-493. DOI 10.1016/j.apt.2014.12.002.

Teichmann, J., v. d. Boogaart, K. G. (2015): Cluster models for random particle aggregates - Morphological statistics and collision distance. Spatial Statistics, Vol. 12, pp. 65-80, DOI 10.1016/j.spasta.2015.03.002.

Subproject B05

Storm, J., Abendroth, M., Kuna, M. E., Aneziris, C. G. (2015): Influence of curved struts, anisotropic pores and strut cavities on the effective elastic properties of open-cell foams. Mechanics of Materials, Vol. 86, pp. 1-10, DOI 10.1016/j.mechmat.2015.02.012.

Subproject B06N, in advance

Gladkyy, A., Schwarze, R. (2014): Comparison of Different Capillary Bridge Models for Application in the Discrete Element Method. Granular Matter, Vol. 16, Iss. 2, pp. 911-920, DOI 10.10007/s10035-014-0527-z.

Kratzsch, C., Timmel, K., Eckert, S., Schwarze, R. (2015): URANS Simulation of Continuous Casting Mold Flows: Assessment of Revised Turbulence Models. Steel Research International, Vol. 86, Iss. 4, pp. 400-410, DOI 10.1002/srin.201400097.

Schwarze, R., Haubold, D., Kratzsch, C. (2015): Numerical study of effects of pour box design on tundish flow characterisation. Ironmaking and Steelmaking, Vol. 42, Iss. 2, pp. 148-153, DOI 10.1179/1743281214Y.0000000221.

Project area C - Filter performance, materials properties

Subproject C05

Henschel, S., Krüger, L. (2015): Charakterisierung der dynamischen Rissinitiierung mittels eines Split-Hopkinson Pressure Bar. In: P. Hübner (Hg.): 47. Tagung des DVM-Arbeitskreise Bruchvorgänge. Bruchmechanische Werkstoff- und Bauteilbewertung: Beanspruchungsanalyse, Prüfmethoden und Anwendungen. Freiberg, 10.–11. Februar. Berlin: Deutscher Verband für Materialforschung und -prüfung e.V. (DVM-Bericht, 247), S. 143–152, ISSN 1616-4687.

Henschel, S., Krüger, L. (2015): Modelling of crack initiation in a G42CrMo4 steel with non-metallic inclusions. Steel Research International, Vol. 86, Iss. 4, DOI 10.1002/srin.201400567.

Subproject C06N, in advance

Fankhänel, B., Stelter, M., Voigt, C., Aneziris, C. G. (2015): Wettability of AlSi5Mg on spodumene, Metallurgical and Materials Transaction B, Vol. 46, Iss. 3, pp. 1535-1541, DOI 10.1007/s11663-015-0307-0.

Complementary subprojects

Subproject S02

Lehmann, H., Jung, B. (2014): In-situ multi-resolution and temporal data compression for visual exploration of large-scale scientific simulations. The 4th IEEE Symposium on Large Data Analysis and Visualization - LDAV 2014, November 9-10, 2014 Paris, France, DOI 10.1109/LDAV.2014.7013204. *Best Paper Honorable Mention*

Lehmann, H, Lenk, M., Jung, B. (2014): Adding Interlacing to In-Situ Data Compression for Multi-Resolution Visualization of Large-Scale Scientific Simulations. International Conference on Artificial Reality and Telexistence & Eurographics Symposium on Virtual Environments - ICAT-EGVE 2014, December 8-10, 2014, Bremen, Posters and Demos, pp. 5-6, ISBN 978-3-905674-77-4, DOI 10.2312/ve.20141370.

On the occasion of the 250th anniversary of the TU Bergakademie Freiberg, a **special edition on the university's materials research activities was published by the Deutsche Gesellschaft für Materialkunde e.V. (DGM).** The publication entitled "DGM im blickpunkt" presents several highlights, including the Collaborative Research Centers funded by the German Research Foundation DFG, namely the CRC 920 "Multi-Functional Filters for Metal Melt Filtration - A Contribution towards Zero Defect Materials" and the CRC 799 "TRIP Matrix Composite - Design of tough and transformation-toughened composite materials and structures based on Fe ZrO_2." Additionally, institutes of the university involved with materials science and engineering, their fields of research and research infrastructures are introduced.

"A considerable number of coordinated research groups and individual projects underline the university's research strength in materials science and engineering. Continuous technical investments including semi-industrial facilities have created attractive research opportunities," says Prof. Horst Biermann, Vice Coordinator of the CRC 920. This would enable excellent teaching conditions for students, too, Prof. Biermann adds.

With more than 2,300 individual and approximately 200 institutional members the Deutsche Gesellschaft für Materialkunde e.V. DGM is the largest European technical-scientific association in materials science and engineering. Since 2013, the DGM is regularly presenting leading locations of materials research and application across Germany. ■

A new textbook entitled **"Modern methods of materials testing"** picks up current research results obtained in the CRC 920 and the CRC 799 and explicates selected techniques of materials testing specifically of metallic materials. The book comprises 12 chapters which illustrate modern, high-performance methods for identifying mechanical properties as well as methods for analyzing deformed metallic materials in order to investigate relevant structure-property relations.

The textbooks starts with an introduction to fundamental methods. It further visualizes analysis and testing techniques as well as examples from research and application. Special emphasis is given to novel and modified techniques due to novel and advanced materials and testing methods as well as specific requirements for quality, security and environmental management issues.

Targeting both graduate students and researchers in materials science, mechanical engineering as well as industrial engineering and management with a specialization on materials science and engineering, this textbook is a comprehensive resource on innovative testing methods. As the editors Prof. Lutz Krüger and Prof. Horst Biermann point out, the quality of this publication was strongly enhanced by a close and interdisciplinary collaboration between the researchers involved in both CRCs. ■

SAXON ACADEMY OF SCIENCES CALLS EXPERT FROM FREIBERG

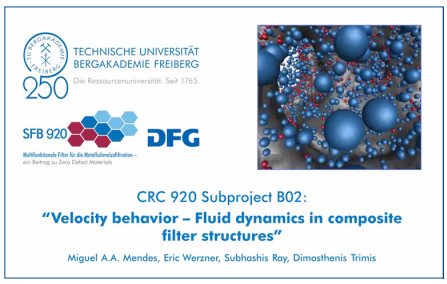
Photo: Prof. Dr. Horst Biermann.

The Saxon Academy of Sciences Leipzig has assigned Prof. Horst Biermann, Vice Coordinator of the CRC 920 and Coordinator of the CRC 799, as full member in the academy's class of engineering sciences. Thereby, he belongs to a group of approximately 200 experts from various academic disciplines who are involved with furthering the sciences, extending and deepening scientific knowledge through research as well as stimulating and fostering scientific investigations and projects.

"I feel deeply honored," says Prof. Biermann. "This assigment does not solely award an individual, it awards my entire group and its achievements throughout the past 15 years of my work at the TU Bergakademie Freiberg. Therefore, I'd wish to thank all members of my working group for their valuable contributions."

Since 2000, Prof. Biermann has been working as a professor and head of department of the Institute of Materials Engineering at the TU Bergakademie Freiberg. He serves as the spokesperson of the German Research Foundation's review board in materials engineering. Moreover, he was the founding chairman of the Association of Faculties of Materials Science and Engineering StMW e.V. ■

SCIENCE COMMUNICATION USING NEW MEDIA



The CRC has published a new online video that explicates the modeling procedure employed to simulate complex filter processes. Using explanations, visualizations and animated scenes, Dr. Miguel A. A. Mendes, Eric Werzner, Dr. Subhshis Ray and Prof. Dimosthenis Trimis present aims and approaches of their CRC subproject, methodological fundaments and applications of their modeling approach. Published on Youtube in March, the video has been downloaded more than 100 times so far. ■

CONFERENCES AND CALLS FOR PAPERS

International CALPHAD Conference, 31.05.-06.06.2015, Loano (Italy): Further information is available at www.calphad.org/meetings/2015/.

14th International Conferece of the European Ceramic Society ECerS 2015, 21.-25.06.2015, Toledo (Spain): Further information is available at www.ecers2015.org.

DGM Materialsweek, 14.-17.09.2015, Dresden: Information about the program, registration and opportunities to submit papers or presentations is available at www.werkstoffwoche.de.

14. UNITECR 2015, 15.-18.09. 2015, Vienna, Austria: Further information is available at www.unitecr2015.org.

9th International Conference on Clean Steel, 08.-10.09.2015, Budapest (Hungary): Further information is available at www.cleansteel9.com.

6th Freiberg Refractory Forum, 09.12.2015, Freiberg: Further information will be available at tu-freiberg.de/forschung/sfb920.

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