SFB 920

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

NEWSLETTER 7 (2/2014)

DFG Deutsche Forschungsgemeinschaft

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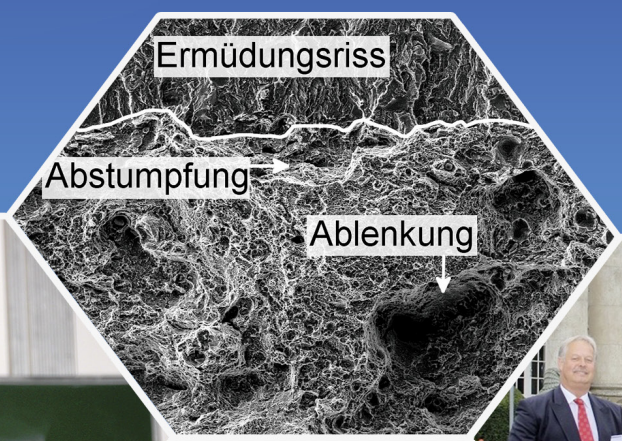


DEAR READERS,

Coordinated programs offered by the German Research Council DFG, such as Coordinated Research Centers, are playing a vital role in basic research, not only for materials science and engineering. This is particulary true with regard to the qualification of young researchers. The range of topics and complexity of research objects pursued in a CRC offer attractive dissertation projects and interesting opportunities to work in teams and networks right from the beginning. Additionally, the Integrated Graduate Program provides critical resources which enable doctoral students to graduate in an appropriate time and with excellent results.

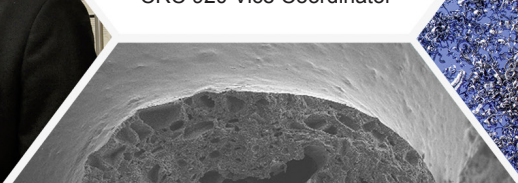
Meanwhile, the first doctoral students of the CRC 920 have successfully finished their dissertation projects. Among them, one student was awarded with one of the most prestigious prices in refractory research. Details on these and other activities are available in our latest issue of this newsletter. Further information is provided at http://sfb920.tu-freiberg.de. We hope you'll enjoy the newsletter.

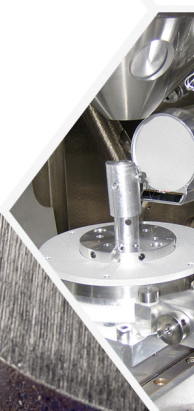
Yours sincerely,

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

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

CONTENT





INTERNATIONAL AUTUMN SCHOOL AND INTERNATIONAL VISITING PROFESSORS

Again, several international scholars followed an invitation of the Collaborative Research Center and joined the CRC team. Experts from India, Ukraine, and Czech Republic offered seminars and workshops. Moreover, they provided their advice and assistance to several CRC subprojects. An International Autumn School of EMPA and CRC 920 invited young researchers of the CRC 920 to present results obtained during the program's first period.

On November 6, 2014, doctoral students were invited to an **International Autumn School, jointly coordinated by the CRC 920 and the EMPA**, entitled "Grain boundary design for the material development as well as for functionality during application." The Autumn School was opened by Professor Christos G. Aneziris, CRC coordinator, and Professor Thomas Graule, director of the high performance ceramics unit at the Eidgenössische Materialprüfungs- und Forschungsanstalt EMPA (Switzerland).

The EMPA high performance ceramics unit in Dübendorf (Switzerland) assembles internationally leading experts on the field of nanoparticles, nanodisperse systems, ceramic forming technologies as well as colloid chemistry. EMPA is an interdisciplinary research and services institution for material sciences and technology development within the ETH domain.

As an introduction to the scientific program, representatives of EMPA provided insights into applications of porous ceramics, boundary surface phenomena as well as ways to generate ceramic composites.

Photo: Professor Thomas Graule (EMPA, Switzerland)

The presentations held by young scientists of the CRC 920 covered all three project areas that constitute the coordinated program during its first period. Results from the project area "Filter materials" pertaining to the generation of filter materials for metal melt filtration were presented by Dr. Marcus Emmel. Dipl.-Ing. Tilo Zienert showed findings on "Thermodynamics between filter wall and inclusions," obtained in the project area "Modeling of filter structures and filter systems." Materials properties of the filter materials developed in the CRC and the resulting filter efficiency was discussed based on the presentation of Dipl.-Ing. Dominik Krewerth. He showed findings of investigations on the fatigue behavior of metallurgic products due to inclusions and conclusions on the filter efficiency.

The International Autumn School completed a course of lectures held by **international visiting scholars**. From June 1 to July 15, 2014, **Professor Prabal Talukdar from the Indian Institute of Technology Delhi** visited the TU Bergakademie Freiberg. Prof. Talukdar is working in the field of modeling radiation and high temperature phenomena. Additional to his guest presentation, he participated in investigations in subproject B02 aimed at the evaluation of the volumetric heat transfer coefficient in porous media at very high temperatures and various fluids.

From June 1 to August 31, 2014, the CRC 920 welcomed **Dr. Liya Dreval from the Donbass State Engineering Academy Kramatorsk (Ukraine)**. Dr. Dreval is an expert in thermodynamic modeling.

Photo: Professor Prabal Talukdar (Indian Institute of Technology, Delhi)

During her visit, she assisted the research in subproject A03, coordinated by Dr. Fabrichnaya, on the evaluation of the system Al-Fe-O. Moreover, Dr. Dreval offered doctoral students of the CRC a seminar on calorimetric investigation of the mixing enthalpy in alloys as well as on thermodynamic calculations of the Al-Fe-O system.

A workshop run by **Dr. Zdeněk Matěj from Karl University Prague (Czech Republic)** introduced X-ray powder diffractometry as a tool for the analysis of materials to doctoral students and research assistants. Besides fundamentals, the workshop also included a software training for the program "MStruct." ■

FIRST CRC DOCTORAL STUDENT RECEIVES HIS PH.D. ... AND THE GUSTAV EIRICH AWARD

Dr. Marcus Emmel is the first doctoral student of the CRC 920 who successfully finished his dissertation. Prior to this, on the occasion of the 57th International Colloquium on Refractories in Aachen, he received the Gustav Eirich Award for his scientific work. An international jury honored the candidate's contributions to the research on novel refractory filter materials.

On October 8, 2014, Dr.-Ing. Marcus Emmel passed his dissertation defense "with distinction." The thesis entitled **"Development of active and reactive carbon bonded filter materials for steel melt filtration"** was supervised by Professor Christos G. Aneziris.

The dissertation focused on the development of active and reactive filter systems in the Al_2O_3/MgO-C system, able to reduce inclusions in steel melts. Novel filter materials with functionalized surfaces based on active, ceramic coatings and combined with tailored pressure ratios resulted in significant reductions of selected inclusions showing similar chemical properties and cristal systems in steel melts at 1600 °C. In addition to that, for the first time a decrease of gas impurities was accomplished by employing reactive filter surfaces which react with gases solved in the melts.

Prior to the official defense of his dissertation, Dr. Emmel won the **2. Price of the Gustav Eirich Award in recognition of his scientific merits in the field of refractory materials**. In September 2014, on the occasion of the 57th International Colloquium on Refractories in Aachen in September 2014, Dr.-Ing. Christoph Heynen from the Maschinenfabrik Gustav Eirich GmbH Hardheim and Professor Peter Quirmbach from the ECRef European Center for Refractories gem. Gmbh delivered the certificate as well as a prize money of 2,000 Euros.

Once a year, the Maschinenfabrik Gustav Eirich GmbH in Hardheim and the ECRef European Center for Refractories gem. GmbH, representing the scientific institution of the German Association of the Refractory Industry e.V., assign the Gustav Eirich Award to young graduates and postdoctorates in the engineering sciences. Awardees are designated by an international jury which includes representatives from academia and industry, based on a simple majority.

Photo: Dr. Marcus Emmel (second from right), one of the awardees of Gustav Eirich Awards 2014, as well as members of the jury Professor Peter Quirmbach (ECREF gem. GmbH; left) and Dr.-Ing. Christoph Heynen (Maschinenfabrik Gustav Eirich GmbH; right).

Since 2011, Marcus Emmel is involved in the CRC 920 as research assistant. Since then, he co-authored 15 reviewed publications as well as two patents on the field of refractory filter materials. ■

MORE NEWS

More than 100 presentations of latest research results on cellular materials were given at the **3rd CellMAT conference, which took place from October 22 to October 24, 2014 in Dresden.** Three presentations of the CRC 920 offered insights into its research activities: Johannes Storm (subproject B05), Claudia Voigt (subproject A02), and Eric Werzner (subproject B02) introduced the CRC to an international audience of academics and industry representatives.

In October 2014, **Claudia Voigt was a visiting scholar with Professor Merete Tangstad from the SINTEF Materials and Chemistry Research Group in Trondheim/Norway.** This research group offers testing facilities which allow the measurement of wetting angles even at high vacuum as well as high levels of expertise with related testing regimes. Capturing wetting angles for materials tested in subproject A02 is challenging due the aluminum's tendency to oxidize. Collaborating with the Norwegian colleagues strongly facilitated successful data collection. ■

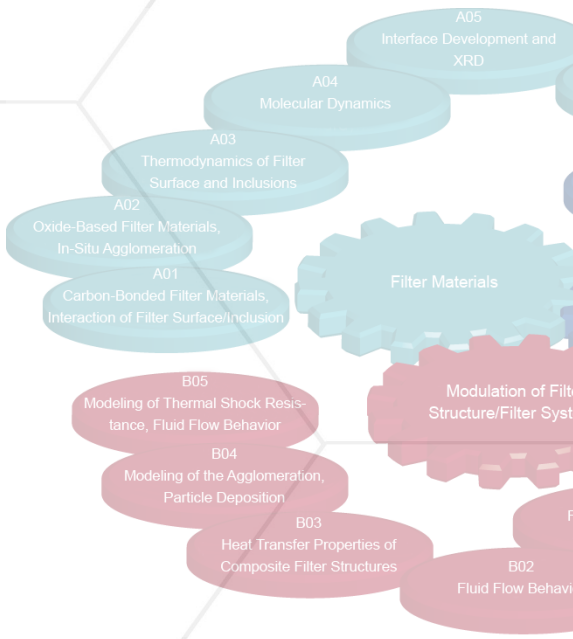
Photo (from left to right): Claudia Voigt, Paolo Colombo (University of Padua/Italy), Eric Werzner

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.

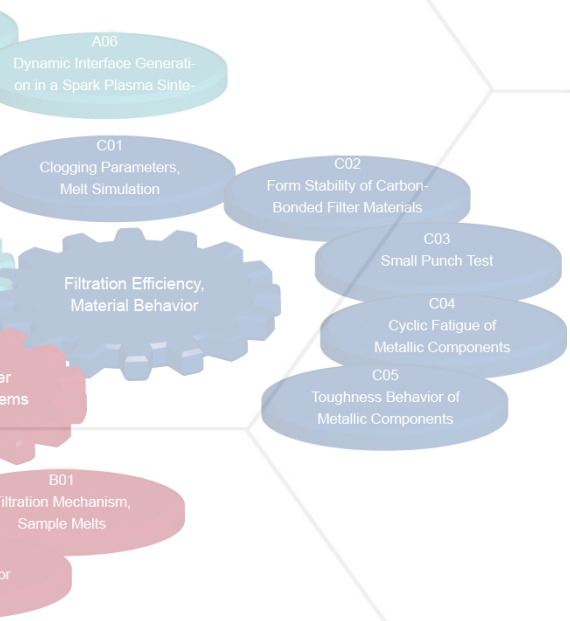
Working Group 1: "Metal melt/inclusions, active/reactive filter materials, boundary surface design" (Coordination: Dipl.-Ing. Tilo Zienert)

- Production of substrates and wetting experiments at INEMAT (TU Freiberg) and at SINTEF (Trondheim, Norway) (A02),
- Experimental measurement of the heat capacity of eta-AlFe, thermodynamic calculations on the filter stability for Al-melt filtration (A03),
- Calculation of the heat capacity of eta-AlFe with DFT (A04),
- Observation of in-situ formed $MgAl_2O_4$ spinel layers at the MgO-C/Al_2O_3-C filter surface and on Al_2O_3 inclusions. Also spinel whiskers were found. The in-situ formed alumina layer on alumina-C material in contact with molten steel were found in SPS experiments too (A06),
- Realisation of dip and flow experiments within the steel melt simulator, observation of an in-situ formed alumina layer on the substrate materials, which seems to have positive clogging properties with respect to the endogeneous alumina inclusions (C01),
- Measurement of the volumetric heat-transfer coefficent for aluminium and steel melt filtrations together with B03, first experiments with the Prefil-Footprint system for characterisation of the filtration of aluminium melts (S03),
- Evaluation of the LIMCA experiments, which were done during industry casting (Constellium) (A02, S03),
- Realisation and evaluation of steel melt infiltration experiments of carbon nano tubes containing Al_2O_3-C filter (E. Storti, Ph.D. scholar, IKGB).



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

- Investigations on the homogenization of materials properties using a Kelvin cell, with particular regard to elastic and plastic mechanic properties of the structure, as well as evaluation of local tensions within the cell in order to identify failure and minimal yield surfaces (B05),
- Tests on bending relaxation, pressure relaxation, and pressure creeping; test series for estimating the impact of temperature on creeping properties , ranging between 800 °C and 1400 °C (C02),
- SPT tests and pressure tests with miniaturized samples; description of the variance of materials properties at compressive failure using the Weibull theory; tests of tensile strength and compression strength at 800 °C (C03).



Working Group 2: "Modeling and designing of the filter geometry" (Coordination: Miguel Mendes, Ph.D.)

- Comparison between detailed model predictions and experiments carried out by subproject B03 regarding metal melt filtration in real filters; development of numerical tools to predict particle dispersion and residence time near the filter wall as well as permeability and volumetric heat transfer coefficient of filters (B02),
- Experimental evaluation of the volumetric heat transfer coefficient for ceramic foams (10, 20, and 30 ppi) in air; estimation of effective thermal conductivity of ceramic filter foams at high temperatures using TPS technique and at room temperature (B03),
- Investigations using the QICPIC technique to obtain information about the morphology of alumina particle agglomerates; modification and extension of the model of population balance equation in order to consider non-spherical particles (fractal structures) as well as turbulent motions; generation of a data set of tracked particles on a periodic Kelvin cell in cooperation with subproject B02; analysis of the trajectories of individual particles in order to calculate probabilities of agglomerate formation (B04),
- Video production of "VR-based visual analysis of filtration processes" in the CAVE (S02, B02).

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

- Usage of the metal melt casting simulator to create samples with specific particle distributions suitable for static and dynamic experiments (C01, C05),
- Launching the preload frame of the ultrasonic fatigue testing machine for additional high-frequency fatigue tests with varying amplitudes and under preload (R > 0) (C04),
- Deep etching and dissolving non-metallic inclusions from the heat-treatment steel matrix (G42CrMo4) in order to determine the morphology, chemical composition, and structure of inclusions using REM combined with EBSD and EDX measures (C04, S01).

FUNCTIONALIZING MATERIALS FOR ACTIVE AND REACTIVE FILTER SYSTEMS

Author: Marcus Emmel
(Subproject A01)

Subproject A01 aims at investigating novel active and reactive ceramic filter materials based on carbon-bonded alumina and carbon-bonded magnesia suitable for steel melt filtration. By adjusting interfacial surface tensions, filter efficiency can be increased significantly.

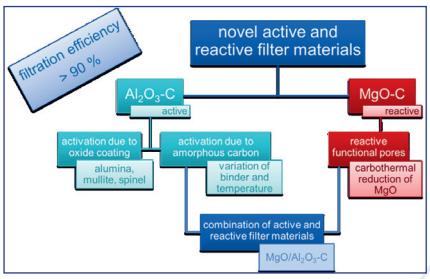


Fig. 1: Schematic overview of the respective materials and functionalities

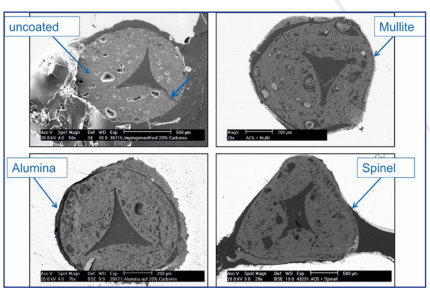


Fig. 2: Cross sections of the oxide coated filter struts after the impingement test

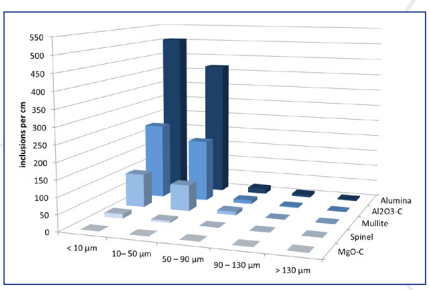


Fig. 3: Amount of trapped exogenous alumina as a function of filter chemistry

The development of filter materials for steel melt filtration, based on carbon bonded alumina, was achieved in the present work. These filters served as substrates for further functionalization processes in terms of so-called active filters (see Fig. 1). In order to functionalize the carbon bonded alumina filter via increasing amorphous carbon amounts, filters were spray-coated with resin in order to generate pure amorphous carbon surfaces. The resin infiltrated the pores of the thermally pretreated filters, resulting in decreasing open porosity, increasing cold crushing strengths as well as increasing Young´s modulus of elasticity and, thus, in poor thermal shock resistance. Hence, the influence of varying coking temperatures (800 °C or 1400 °C) on the properties of carbon-bonded alumina filters was determined. Only minor changes in the CCS as well as in the Young´s modulus of the filters, coked at 1400 °C, occurred. This led to the pass of the impingement test.

In terms of the second functionalization approach, new active oxide coated filters for steel melt filtration, with a coating thickness of approx. 50-80 µm, have been developed. A sintering temperature of 1400 °C led to the generation of tight coated filter systems, due to a pronounced shrinkage of the coating materials onto the filter struts. In addition, the sintering as well as the cooling shrinkage, generated compressive stresses that counteract the peak stresses of the hollow filter struts, resulting in higher cold crushing strengths. The amount of the CCS increase was dependent on the sintering activity of the respective oxides. Therefore, the CCS decreased from alumina over spinel to mullite. Hence, the applicability of the newly developed filter systems in consideration of their thermal shock resistance, as well as their permeability, was approved (see Fig. 2).

Despite the fact that MgO is susceptible to hydration, leading to brucite formation, the application of thin, water based coatings, on carbon bonded alumina substrates, was possible, resulting in reactive MgO-C filters. As a result of the low packing densities, the bigger particle sizes and the pronounced thermal expansion coefficient, these filters possessed very low cold crushing strengths, as well as no dimension stability. Hence, the production of pure magnesia containing filters had been proven to be impractical. Therefore, the carbon bonded alumina composition was used as a first, impregnated layer. In combination with a MgO-C spraying layer, stable filters with a wall thickness distribution of 400-600 µm (± 330 µm), which passed the impingement test, were generated.

In order to combine the functionalities of the active and reactive filters and to exploit the volume expansion of the in situ spinel formation, filters based on the system MgO/Al_2O_3-C were produced. The formation of spinel reduced the overall shrinkage of the ceramic materials, which is detrimental in filtration applications because it reduces the permeability of the filters. The data prove that these innovative systems can be successfully used for molten steel filtration. Finally, a selection of newly developed filters was tested in collaboration with the industry. Present work has verified the influence of the chemistry of varying filter materials on the filtration of exogenous alumina as well as spinel inclusions. That implies that the higher the alumina amount on the surface is present in the filter system, the more nonmetallic inclusions are getting trapped on the filter surface (see Fig. 3). ■

EFFECTS OF NONMETALLIC INCLUSIONS ON DYNAMIC CRACK INITIATION

Effects of material inhomogenities, especially of impurities due to nonmetallic inclusions, on materials strength, deformation, and failure behavior as well as structure-dependent factors are in the focus of subproject C05. The overall objective is the development of damage-tolerant security components.

Author: Sebastian Henschel
(Subproject C05)

The aim of subproject C05 is the investigation of the effect of temperature and loading rate on the toughness behaviour of the quenched and tempered steel G42CrMo4. Hence, the influence of the non-filtered non-metallic inclusions on the capacity of the material to withstand loads is studied by experiments.

The effect of non-metallic inclusions on the resistance to crack initiation and crack growth is characterised in a wide range of temperatures and loading rates. In addition to tests with quasi-static loading, dynamic tests at loading rates of approximately 10^5 MPam$^{0.5}$s^{-1} were performed. An instrumented pendulum impact testing machine was utilised at this loading rate. In the test, a precracked bend specimen is loaded dynamically in order to extend the crack. The history of the load and the subsequently derived deflection is usually used to determine the materials toughness. In the present study, a laser-based deflection measurement was utilised in order to achieve an independent verification of the established method (see Fig. 1). Differences between the two methods were observed and were attributed to different boundary conditions and the dynamic testing conditions.

The detrimental effect of non-metallic inclusions on the crack resistance was shown by fractographic investigations. The blunting of the crack, which is a measure of the crack resistance, is minimised by inclusions, which are located directly at the front of the precrack. The direction of crack growth is significantly affected by agglomerations or clusters of non-metallic inclusions. The local weakening of the material results in a crack path deflection towards the inclusion cluster (see Fig. 2). Hence, there is not only the intended crack opening mode I but also locally a superposition with modes II and III. The studied steel shows no embrittlement even at low temperatures of -40 °C in combination with dynamic loading. Lower temperatures of -60 °C resulted in small portions of cleavage fracture. However, the presence of the cleavage fracture facets is not inevitably linked with the existence of non-metallic inclusions. Fig. 3 shows cleavage facets which are not associated with a cluster of non-metallic inclusions.

Further tests at higher loading rates are intended in order to evaluate the temperature and loading rate dependent toughness behaviour comprehensively. The transition from ductile to brittle behaviour is expected to be at higher temperatures than -60 °C due to the embrittling effect of the loading rate. Additionally, adiabatic heating is expected at very high loading rates. Hence, a prediction of the effect of loading rate on the toughness is currently not possible and an experimental evaluation is necessary. ■

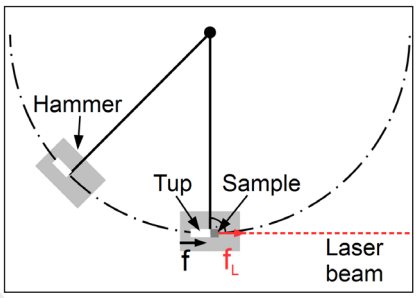


Fig. 1: Schematic drawing of the pendulum impact testing machine

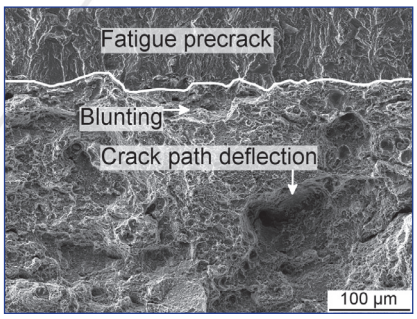


Fig. 2: Crack path deflection by a inclusion cluster (IG3-P3, -40 °C, *dK/dt* = 1.1*10^5 MPam$^{0.5}$s^{-1})

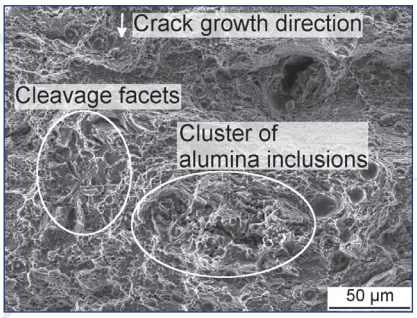


Fig. 3: Cleavage fracture facets which are not associated with the inclusion cluster (IG3-P3, -60 °C, *dK/dt* = 8.6*10^4 MPam$^{0.5}$s^{-1})

RECENT PUBLICATIONS

Project area A - Filter materials

Subproject A01

Aneziris, C. G., Emmel, M., Dudczig, S. (2014): Functionalised Carbon Bonded Filters for Advanced Metal Melt Filtration. India International Refractories Congress 2014 - IREFCON 14, 15-18 January, 2014, Kolkata, India.

Aneziris, C. G., Emmel, M., Dudczig, S. (2014): A New Generation of Carbon Bonded Filters for Advanced Metal Melt Filtration. 13th International Ceramic Congress and 6th Forum on New Materials - CIMTEC 2014, June, 8-19, 2014, Invited Lectures, Code.-No.: C14/1700, accepted: 20.02.2014.

Emmel, M., Aneziris, C. G., Schröder, C. (2014): Ermittlung der Abscheidetendenz endogener, nichtmetallischer Einschlüsse gegenüber oxidischen Partikeln mittels konfokalem Laserscanning-Mikroskop. DKG Jahrestagung, 24.-26. März 2014 in Clausthal-Zellerfeld, Germany.

Emmel, M., Sponza, F., Dudczig, S., Aneziris, C. G., Colombo, P. (2014): In situ Spinel Formation in Al_2O_3-MgO-C Filter Materials for Steel Melt Filtration. Ceramics International. Vol. 40, Issue 8, Part B, September 2014, pp. 13507-13513, DOI: 10.1016/j.ceramint.2014.05.033.

Subproject A02

Voigt, C., Zienert, T., Schubert, P, Aneziris, C. G., Hubálková, J. (2014): Reticulated porous foam ceramics with different surface chemistries. Journal of the American Ceramic Society, Vol. 97, Iss. 7, July (2014), pp. 2046-2053, DOI 10.1111/jace.12977.

Voigt, C., Fankhänel, B., Jäckel, E., Aneziris, C. G., Stelter, M., Hubálková, J. (2014): Effect of the filter surface chemistry on the filtration of aluminum. Metallurgical and Materials Transactions B, accepted: 14.10.2014, DOI 10.1007/s11663-014-0232-7.

Subproject A03

Zienert, T., Dudczig, S., Fabrichnaya, O., Aneziris, C. G. (2014): Interface reactions between liquid iron and alumina-carbon refractory filter materials. Ceramics International, Manuscript-ID: CERI9263, accepted: 02.10.2014, DOI 10.1016/j.ceramint.2014.10.004.

Subproject A04

Amirkhanyan, J., Weissbach, T., Gruber, Th., Kortus, J., Zienert, T., Fabrichnaya, O. (2014): Thermodynamic investigation of Al-Fe-Si intermetallic ternary phases: A Density - Functional Theory Study. Journal of Alloys and Compounds. Vol. 598, 15 June 2014, pp. 137-141, DOI 10.1016/j.jallcom.2014.01.234.

Amirkhanyan, L., Weißbach, T., Kortus, J., Aneziris, C. G. (2014): On the possibility of hercynite formation in a solid state reaction at the Al_2O_3-iron interface: A density-functional theory study. Ceramics International, Vol. 40, Iss. 1, Part A, January 2014, pp. 257-262, DOI 10.1016/j.ceramint.2013.05.132.

Röder, C, Weißbach, T., Kortus, J., Himcinschi, C., Dudczig, S., Aneziris, C. G. (2014): Raman spectroscopic characterization of novel carbon-bonded filter compositions for steel melt filtration. Journal of Raman Spectroscopy. Vol. 45, Iss. 1, January 2014, pp. 128-132, DOI 10.1002/jrs.4426.

Subproject A05

Dopita, M., Emmel, M., Salomon, A., Rudolph, M., Metej, Z., Aneziris, C. G., Rafaja, D. (2014): Temperature evolution of microstructure of turbostratic high melting coal-tar synthetic pitch studied using wide-angle X-ray scattering method. Carbon, Ms.Ref.No.: CARBON-D-14-01088R2, accepted: 18.09.2014, DOI 10.1016/j.carbon.2014.09.058.

Subproject A06

Salomon, A., Emmel, M., Dopita, M., Dudczig, S., Aneziris, C. G., Rafaja, D. (2014): Reaction mechanism between the carbon bonded magnesia coatings deposited on carbon bonded alumina and a steel melt. Journal of the European Ceramic Society, Ms.Ref.No.: JECS-D-14-00944R2, accepted: 21.09.2014, DOI 10.1016/j.jeurceramsoc.2014.09.033.

Project area B - Modeling of filter structures/ filter systems

Subproject B01

Heuzeroth, F., Fritzsche, J., Peuker, U. A. (2014): Raster-Kraft-Mikroskopie zur Evaluation der Abscheideeffizienz bei der Metallschmelzefiltration. Chemie Ingenieur Technik – Sonderheft „Aufbereitungstechnik“, 86 [6] (2014), pp. 874-882, DOI 10.1002/cite.201300183.

Heuzeroth, F., Fritzsche, J., Peuker, U. A. (2014): Wetting and its influence on the filtration ability of ceramic foam filters. Particuology, accepted: 03.06.2014, DOI 10.1016/j.partic.2014.06.001.

Heuzeroth, F., Peuker, U. A. (2014): Experimentelle Modellierung der Tiefenfiltration von Metallschmelzen durch ein wasserbasiertes Modellsystem. Jahrestreffen der ProcessNet-Fachgruppen „Mechanische Flüssigkeitsabtrennung“ und „Trocknungstechnik“ (Vortrag), 19.-21. Februar 2014, Karlsruhe.

Subproject B02

Mendes, M. A. A., Ray, S., Trimis. D. (2014): Evaluation of Effective Thermal Conductivity of Porous Foams in Presence of Arbitrary Working Fluid. International Journal of Thermal Science, Vol. 79, May 2014, pp. 260-265, DOI 10.1016/j.ijthermalsci.2014.01.009.

Mendes, M. A. A., Ray, S., Trimis, D. (2014): An improved model for the effective thermal conductivity of open-cell porous foams. International Journal of Heat and Mass Transfer. Vol. 75, August 2014, pp. 224-230, DOI: 10.1016/j.ijheatmasstransfer.2014.02.076.

Mendes, M. A. A., Assad, A., Werzner, E., Götze, P., Ray, S., Trimis, D. (2014): Sensitivity Analysis of Effective Thermal Conductivity of Open-Cell Ceramic Foams Using a Simplified Model Based on Detailed Structure. 5th International Conference on Porous Media and Their Applications in Science, Engineering and Industry, ICPM5, June 22-27, 2014, Kona, Hawaii, Eds, ECI Symposium Series, Vol. (2014), ECI Digital Archives.

Mendes, M. A. A., Skibina, S., Talukdar, P., Wulf, R., Trimis, D., Gross, U., Ray, R. (2014): Experimental validation of simplified conduction-radiation models for evaluation of effective thermal conductivity of open-cell metal foams at high temperatures. International Journal of Heat and Mass Transfer, Vol. 78, November 2014, pp. 112-120, DOI 10.1016/j.ijheatmasstranfer.2014.05.058.

Subproject B03

Vijay, D., Götze, P., Wulf, R., Gross, U. (2014): Volumetric heat transfer determination for forced convection of air through alumina (Al_2O_3) foam. 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 15-8769.

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. 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.

Wulf, R., Mendes, M. A. A., Skibina, V., Al-Zoubi, A., Trimis, D., Ray, S., Gross, U. (2014): Experimental and Numerical Determination of Effective Thermal Conductivity of Open Cell FeCrAl-alloy Metal Foams. International Journal of Thermal Sciences, Vol. 86, December 2014, pp. 95-103, DOI 10.1016/j.ijthermalsci.2014.06.030.

Subproject B04

Fritzsche, J., Peuker, U. A. (2014): Particle adhesion on highly rough hydrophobic surfaces: The distribution of interaction mechanisms. Colloids and Surfaces A: Physicochemical and Engineering Aspects, Vol. 459, 5 October 2014, pp. 166-171, DOI 10.1016/j.colsurfa.2014.07.002.

Fritzsche, J., Peuker, U. A. (2014): Wetting and adhesive forces on rough surfaces - An experimental and theoretical study. The 7th World Congress on Particle Technology (WCPT7), May 19-22, 2014, in Beijing, China. Procedia Engineering (2014), accepted: 16.10.2014.

Project area C - Filter performance, materials properties

Subproject C01

Werner, J., Aneziris, C. G., Schafföner, S. (2014): Influence of porosity on Young's modulus of carbon-bonded alumina from room temperature up to 1450°C. Ceramics International, Vol. 40, Issue 9, Part A, November 2014, pp. 14439–14445, DOI 10.1016/j.ceramint.2014.07.013.

Dudczig, S., Aneziris, C. G., Hubálková, J., Schmidt, G., Berek, H. (2014): Characterization of carbon bonded alumina filters with active or reactive coatings in a steel casting simulator. Ceramics International, Vol. 40, Issue 10, Part B, 2014, pp. 16727-16742, DOI 10.1016/j.ceramint.2014.08.038.

Subproject C03

Soltysiak, S., Abendroth, Kuna, M., Klemm, Y., Biermann, H. (2014): Strength of fine grained carbon-bonded alumina (Al_2O_3) materials obtained by means of the small punch test. Ceramics International. Vol. 40 Issue 7, Part A, August 2014, pp. 9555-9561. DOI 10.1016/j.ceramint.2014.02.030.

Soltysiak, S., Selent, M., Roth, S., Abendroth, M., Hoffmann, M., Biermann, H., Kuna, M. (2014): High-temperature small punch test for mechanical characterization of a nickel-base super-alloy. Materials Science & Engineering A, Vol. 613, 8 September 2014, pp. 259-263, DOI 10.1016/j.msea.2014.06.105.

Soltysiak, S., Abendroth, M., Kuna, M. (2014): Determination of tension compression anisotropy of fine grained carbon bonded alumina by means of the small punch test and the miniaturized compression test. Proceedings of the 3rd International Conference SSTT 2014, 23.-25.09.2014, Seggau, Österreich, ISBN 978-80-260-6722-1.

Subproject C04

Krewerth, D., Weidner, A., Biermann, H. (2014): A comparative study on infrared thermography during ultrasonic fatigue testing of cast steel 42CrMo4 and cast aluminium alloy AlSi7Mg. Key Engineering Materials, Special Issue, Prodeecings of MSMF7, 01-03 July 2013, Brno, Czech Republik. Vol. 592-593, 2014, pp. 501-504, DOI 10.4028/www.scientific.net/KEM.592-593.501.

Krewerth, D., Weidner, A., Biermann, H. (2014): Fatigue crack initiation and damage mechanisms during ultrasonic fatigue testing of cast aluminium alloy AlSi7Mg. The 2nd International Symposium on Fatigue Design & Materials Defects, FDMD II, 11-13 June, 2014, Paris, France. In: MATEC Web of Conferences. Vol.12 (2014), p. 10005, DOI 10.1051/matecconf/20141210005.

Weidner, A., Krewerth, D., Biermann, H. (2014): Ermüdung bei sehr hohen Zyklenzahlen (VHCF). In: Moderne Methoden der Werkstofftechnik, Hrsg.: H. Biermann, I. Krüger, Wiley-VCH: Weinheim (2014), ISBN 978-3-527-33413-1.

Subproject C05

Henschel, S., Krüger, L. (2014): Effect of nonmetallic inclusions on the local mechanical behaviour of a G42CrMo4 casting. The 2nd International Symposium on Fatigue Design & Materials Defects, FDMD II, 11-13 June, 2014, Paris, France. In: MATEC Web of Conferences 12, p. 4007, DOI 10.1051/matecconf/20141204007.

Krüger, L., Trubitz, P., Henschel, S. (2014): Bruchmechanisches Verhalten unter quasistatischer und schlagartiger Beanspruchung. In: H. Biermann und L. Krüger (Hg.): Moderne Methoden der Werkstoffprüfung, Weinheim: Wiley VCH , ISBN 978-3-527-33413-1.

Complementary subprojects

Subproject S01

Berek, H., Hubálková, J., Aneziris, C. G. (2014): Röntgen-Tomografie. In: Biermann, H., Krüger, L. (Hrsg.): Moderne Methoden der Werkstoffprüfung. Wiley-VCH Verlag Weinheim, S. 353-385, ISBN 978-3-527-33413-1.

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, accepted for presentation: 01.08.2014.

Subproject Z

Fischer, U., Aneziris C. G. (2014): „Intelligente" keramische Filter für höchstbeanspruchte Sicherheitsbauteile – Schlüssel für neue High-Tech Produkte der Zukunft. Dialog, Materialwissenschaften und Werkstofftechnik, Hrsg.: DGM, Ausgabe 3, Mai 2014, S. 10-15, ISSN 2193-3383. Ausgabe 2014.

Patents

Aneziris, C. G., Emmel, M., Dudczig, S. Deutsches Patent 10 2011 109 684, „Stahl- oder Aluminiumschmelzfilter aus reaktiver Keramik", Anmeldetag 08.08.2011, Patenterteilung am 26.02.2014.

Aneziris, C. G., Dudczig, S., Emmel, M.: „Keramische reaktive Filter für die Metallschmelzefiltration", DE 102011109684 A1, Patenterteilung: 04.03.2014.

Aneziris, C. G., Dudczig, S., Emmel, M. Deutsches Patent, 10 2011 109 681, „Keramische Filter für die Metallschmelzefiltration auf der Grundlage gängiger Metallschmelze-Filtergeometrien und Verfahren zu ihrer Herstellung". Patentanmeldung Nr. 10 2011 109 681.0, Patenterteilung 28.03.2014.

Aneziris, C. G., Gehre, P., Kratschmer, T.: Deutsches Patent, 10 2009 006 778, „Verfahren zur Herstellung eines thermoschock- und korrosionsbeständigen Keramikwerkstoffes auf Basis von Al_2O_3-TiO_2-ZrO_2." Patentanmeldung Nr. 10 2009 006 778.7, Patenterteilung 19.08.2014.

5TH FREIBERG REFRACTORY FORUM

The 5th Freiberg Refractory Forum will take place on November 26, 2014, at TU Bergakademie Freiberg. The program includes invited speeches from national and international guests on current developments in refractory research. Among them, **Professor Farhad Golestani Fard (Iran University of Science and Technology), Anirban Dasgupta (Executive Director of the Indian Refractory Makers Association) as well as Dr. Arup Ghosh (CSIR-Central Glass & Ceramic Research Institute, India)** will share their thoughts and insights. Professor Dr.-Ing. habil. Helge Jansen and Dr.-Ing. Thomas Schemmel (Refratechnik Steel) will present the perspective of the refractory industry. Dipl.-Ing. Steffen Dudczig, Dr. Marcus Emmel, and Professor Christos G. Aneziris will present research results obtained in the CRC 920.

Photo: Attendees of the 4th Freiberg Refractory Forum in November 2014 at the TU Bergakademie Freiberg.

On this occasion, the general meeting of the association "MORE – Meeting of Refractory Experts Freiberg e.V." and the conference of the DGM/DKG technical committee "Refractory Materials" are scheduled. Subsequent to the lectures, a poster session will be presenting research results of the Collaborative Research Center 920 and the Priority Program SPP 1418 "Refractory - Initiative to Reduce Emissions - FIRE". For young scientists involved in the CRC and the Priority Program, the Refractory Forum is therefore a valuable opportunity to extend their knowledge. Moreover, the event will provide the platform for honoring this year's winners of the Theodor Haase Award. Once a year, the MORE Freiberg e.V. assignes this award to students who obtained excellent results on the field of refractory and high temperature applications. The award aims at remembering the Freiberg academic Theodor Haase and his achievements with regard to the education of silicate technology experts.

During the last years, the Freiberg Refractory Forum has become an important platform for an intensive dialogue between academia and industry on the field of refractory materials. A growing number of national as well as international attendees, representing the spheres of research and industry, is a strong indicator for this development.

Photo: The Freiberg Refractory Forum is an important platform for an intensive dialogue between research and industry, but also for the qualification of young scientists (from left to right: Fabian Heuzeroth and Dr. Milan Dopita).

CONFERENCES AND CALLS FOR PAPERS

5th Freiberg Refractory Forum, November 26, 2014, Freiberg: Further information will be available at http://sfb920.tu-freiberg.de.

14th UNITECR 2015, September 15-18, 2015, Vienna, Austria: Deadline for abstract submission: November 15, 2014; Notification of acceptance of abstracts: February 2, 2015; further information available at www.unitecr2015.org.

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

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