SFB 920

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

NEWSLETTER 6 (1/2014)

DFG Deutsche Forschungsgemeinschaft

TECHNISCHE UNIVERSITÄT BERGAKADEMIE FREIBERG
The University of Resources. Since 1765.

DEAR READERS,

Comprehensive and mutually linked research activities, extensive support of the CRC's doctoral students, international visibility, and a continuous exchange with scholars and industry representatives worldwide are what the Collaborate Research Center 920 has been focusing on since its establishment in 2011. Nearly 100 publications and numerous presentations on internationally leading conferences give a glance of the results the CRC has accomplished so far.

Currently, the CRC team is strongly involved with activities required to prepare a second program phase. In February 2015, the German Research Council DFG will evaluate the CRC 920 and decide about the continuation of the endeavour.

Details on these and other activities, results and next steps 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

EXPERTS' FORUM ON REFRACTORY MATERIALS AND APPLICATIONS

More than 120 participants from industry, industry organizations, and universities attended the 4th Freiberg Refractory Forum, which took place at the TU Bergakademie Freiberg. Discussions centered on recent developments of refractory materials and application scenarios. Moreover, attendees celebrated the 10-years anniversary of the partnership between Wuhan University of Science and Technology, China, and the TU Bergakademie Freiberg.

Photo (from left to right): Professor Christos G. Aneziris (coordinator of the CRC 920), Professor Professor Li Nan, Professor Li Yawei (both with Wuhan University of Science and Technology), Liu Baikuan (CEO of the Puyang Refractories Group Co. Ltd.).

In November 2013, the 4th Freiberg Refractory Forum gathered attendees from Germany, Austria, France, Brazil, China, Iran, and Ukraine. A **growing and increasingly international audience** emphasized the relevance of refractory research and the need for intensive relationships between academia, professional organizations, and the industry. The forum was jointly organized by the Collaborative Research Center 920, the Priority Program 1418 "FIRE," the organization MORE - Meeting of Refractory Experts Freiberg e.V., DGM Deutsche Gesellschaft für Materialkunde and DKG Deutsche Keramische Gesellschaft. Additionally, the meeting aimed at supporting the education and qualification of young researchers in refractory engineering.

Speeches and presentations given during the meeting revealed multiple developments in refractory materials systems and methods for characterizing materials properties. In addition, prospective challenges with regard to raw materials supply for refractory materials and applications attracted great interest among the audience. As subsequent discussions demonstrated, intensive dialogue between research and industry is needed in order to cope with future challenges including increasing demands and expectations of final users or legal conditions installed to foster sustainability in the industry.

On the occasion of the 4th Freiberg Refractory Forum, the **10-years anniversary of the partnership between the Wuhan University of Science and Technology, China, and the TU Bergakademie Freiberg** was celebrated. "This partnership frames several joint research activities as well as regular exchanges of students and young academics," Professor Aneziris said. Representatives of the Chinese delegation, namely, Professor Li Yawei and Professor Li Nan from Wuhan University as well as Liu Baikuan, CEO of the Puyang Refractories Group Co. Ltd, offered insights into current research topics as well as into the development of application areas in the Chinese refractory industry.

Photo (from left to right): More than 120 participants from Germany and abroad joined to discuss current developments on the field of refractory materials and applications.

This year's **Theodor Haase award** for excellent final theses on the field of refractory and high-temperature applications was assigned to Daniela Hesky for her investigations of the magnesia-alumina-titanium oxide system. Materials generated from this system own specific structures which make them eligible for thermal shock applications, due to their adaptability to abrupt and extensive temperature changes. The second winner, Katja Schönherr, was awarded for her research on potassium aluminate as a novel basis for materials usable in alkali-containing environments. "Both works are highly innovative and create a basis for tailored solutions to current and prospective demands for refractory materials," Professor Aneziris emphasized.

Dedicated to the memory of the Freiberg academic Theodor Haase and his contributions to the education of young engineers, the MORE - Meeting of Refractory Experts Freiberg e.V. endows the Theodor Haase Award every year for excellent student research works. ■

Photo (from left to right): Professor Christos G. Aneziris and the winners of the Theodor Haase Award 2013, Daniela Lesky and Katja Schönherr.

CROSS-NATIONAL DIALOGUE ON GLOBAL CHALLENGES

Invited as keynote speaker, Professor Christos G. Aneziris presented aims and objectives of the Collaborative Research Center 920 to an international audience. At the 10th India International Refractories Congress IREFCON in Kolkata/India he gave his speech on "Functionalized carbon-bonded filters for improved metal melt filtration."

From January 15-18, more than 500 representatives of the Indian refractory and steel industry met at the 10th India International Refractories Congress IREFCON in Kolkata/India. The congress entitled "Refractories Solutions Through Innovations" was dedicated to interactions between refractory materials and steel melt as well as the potential of **novel filter materials for improvied levels of purity and hence superior properties of metallic high-performance materials**.

Future high-tech products base upon high purity and zero-defect materials. Higher metal qualities and lower defect rates require an even chemical composition and a sufficient purity level of metallic materials. Researchers involved in the Collaborative Research Center 920 "Multi-Functional Filters for Metal Melt Filtration – A Contribution towards Zero Defect Materials" aim to develop **novel, "smart" ceramic filter materials and filter systems** that permit significantly higher levels of metal melt purity, thus enabling lightweight, zero-defect and safe materials. Joint activities of researchers from four faculties of the TU Bergakademie Freiberg are driving innovations in safety and lightweight constructions.

From the beginning, an **industry advisory board** is attending the research team, in order to enhance an early exchange of results and experiences between research and industry and to support the knowledge transfer from basic research into industrial application. The CRC 920 is funded by the German Research Council DFG. Alone during the first program period the ambitious project receives appr. 2.3 mill. Euros per year.

The India International Refractories Congress IREFCON is a biennial international conference that serves as important interface between the Indian and the international refractory industry as well as users of refractory materials, such as producers of steel, cement, nonferrous metalls or glass. In addition to that, the conference addresses suppliers and manufacturers of raw materials, devices and machines, testing facilities, R&D institutions as well as project and consulting organizations. The 10th IREFCON was organized by the Indian Refractory Makers Association IRMA. ■

Photo: More than 500 representatives from refractory and steel industry attended the 10th IREFCON in Kolkata/India.

Photo: Professor Christos G. Aneziris (middle) was invited as keynote speaker of the 10th IREFCON.

NEWS

At the beginning of July, the **CRC homepage** has been adapted to the new corporate design of the TU Bergakademie Freiberg. The revision of the university's internet presentation aimed at a consistent promotion of the vision of "The University of Resources. Since 1765."

The TU Bergakademie Freiberg is committed to principles of work-life balance including proper prioritizing between career and family as well as juggling child-raising and work. Recently appropriate activities have been awarded with two important certifications, namely **"Family-friendly university"** and **"Family and university."** ■

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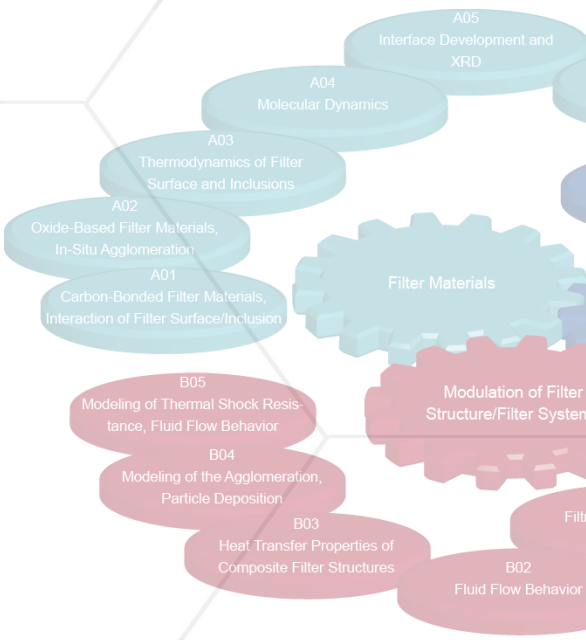
audit familiengerechte hochschule

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.

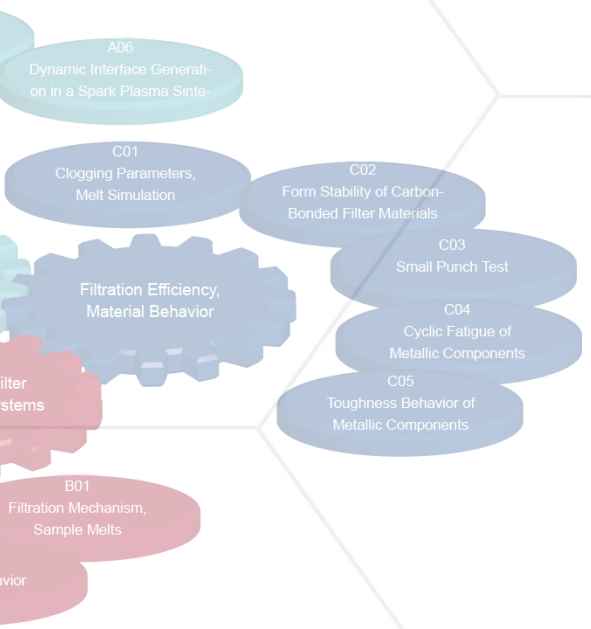
Working Group 1: "Metal melt/inclusions, active/reactive filter materials, boundary surface design" (Coordination: Dipl.-Ing. Tilo Zienert)

- Final field casting tests and filter generation with in-situ spinel formation for improved precipitation efficiency (A01),
- Thermodynamic investigations of reactions within the carbon-bonded system Al_2O_3-C and MgO-C, identification of the influence of iron on boundary surface reactions in the filter (A03),
- Investigations of the impact of surface energy on boundary surface formation between Al_2O_3 and aluminum using the DFT method (A04), planned to be transferred to the melting phase,
- Boundary surface analysis of samples from cast experiments using TEM, implementation of an evaluator routine for the results obtained from x-ray diffraction analyses of carbon samples (A05),
- Successfull implementation of a rapid heating element in the SPS device (enabling temperature changes of several 100K/min), sample generation and characterization based on MgO-C and various spinel compositions in interaction with molten steel (A06),
- Successfull field casting tests with aluminum and subsequent evaluation of the filtration efficiency using PreFil/PoDFA and LiMCA method (S03), launching of the in-situ x-ray equipment at the Institute of Foundry Technology,
- Generation of Al_2O_3 filters with carbon nano tubes (CNT), analysis of direct foaming of the Al_2O_3 filters as a new approach to filter production (responsible: Ph.D. students E. Shorti and A. Pokhrel, IKGB).



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

- Simulation of particle agglomeration at the filter wall during filtration of steel melt with realistic particle sizes and particle size distribution (B02, B04, S02),
- FEM-based evaluation of manufacturing-induced residual stresses in coated filter ligaments after cooling (B05, A01),
- Bending relaxation tests with Al_2O_3-C samples at varying temperatures ranging from 800°C to 1400°C and proof of viscoplastic materials behavior above 1000°C (C02),
- Development of a testing facility for miniaturized pressure tests under argon atmosphere and evaluation of the Al_2O_3-C bending compression strength up to 800°C.



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

- Filtration experiments for different wetting behaviors and fluid velocities. Based on these results, an empirical model developed in order to provide information about of the metal melt process. A single collector test rig designed in order to verify the impact of wetting on the filtration process, using a defined structure. Based on this experiment, the defined filter structure can be transferred into the filtration test rig (B01).
- Particle tracking code parallelized and coupled with 3D fluid flow solver. Evaluation of effective properties of ceramic filters (regarding thermal conductivity, permeability and mass diffusion). Extension of detailed model of particle tracking to account for particle accumulation and agglomeration in progress (B02).
- First measurements of Effective Thermal Conductivity (ETC) of ceramic filters at high temperatures (up to 600°C). ETC of bulk alumina material determined and used as input to model the ETC of ceramic filters. Preliminary investigation of visualization of entrainment of metal melt into the ceramic foam (B03).
- Modeling and investigation of inclusion agglomeration at filter walls. Simulation of the effective size of fractal aggregates. Measurement of capillary interactions between particles and substrate. Modeling of adhesive energies in correlation to the wetting behavior is in progress (B04).
- Determination of important foam-model details for mechanical simulations. Development of a method for analysis of elastic-plastic behavior. Development of an analytical solution of the anisotropic yield surface of the Kelvin cell. Evaluation of residual stresses due to different coating materials in collaboration with sub-project A01 (B05).
- Coupling ISABELA compression algorithm with adaptive multi resolution (AMR) data format. The new approach prepares data in the compression phase, so that it can be directly decompressed in different levels of resolution. The algorithm supports different levels of resolution and outputs VTK AMR format which can be used as input to setup visualization pipelines (S02).

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 (G 42CrMo4) in order to determine the morphology, chemical composition, and structure of inclusions using REM combined with EBSD and EDX measures (C04, S01).

INTERFACE REACTIONS BETWEEN STEEL 42CrMo4 AND MULLITE

Authors: Tilo Zienert, Olga Fabrichnaya (subproject A03)

The CRC 920 aims at the developement of improved coatings on ceramic filters for effective metallic melt filtration. Based on thermodynamic calculations subproject A03 investigates complex phase reactions in high-component systems, in order to understanding relevant chemical reactions during the fabrication of the filters.

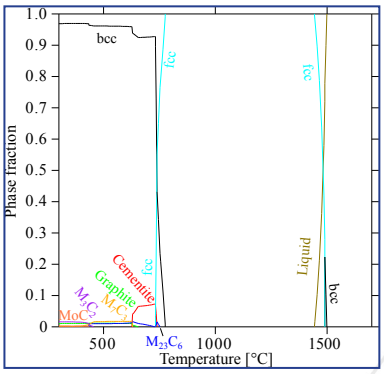


Figure 1: Calculated phase fractions of 42CrMo4 steel in dependence of temperature.

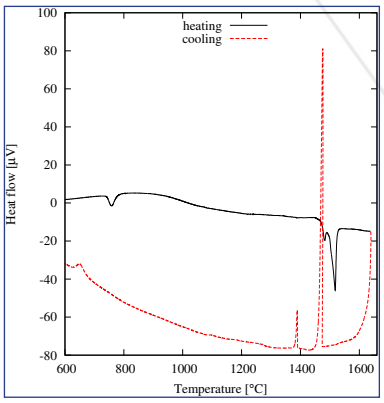


Figure 2: Obtained DTA signal of pure 42CrMo4 steel.

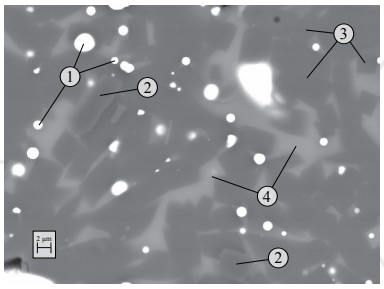


Figure 3: Typical microstructure found after reactions between steel and mullite : (1) steel , (2) α-Al_2O_3, (3) mullite and (4) Mn-rich mullite.

Filters with mullite ($3Al_2O_3 \cdot 2SiO_2$) coatings, produced and tested in subprojects A01 and C01, were investigated with regard to chemical reactions between mullite and steel 42CrMo4. The results will be presented in the following sections. If possible the results of a thermodynamic calculation obtained in A03 will be verified by experimental investigations. In the present case Differential-Thermo-Analysis (DTA) experiments up to 1650°C under argon atmosphere were conducted. After DTA samples were investigated and characterized using XRD, SEM/EDX and SEM/EBSD.

Different powder mixtures of steel and mullite were heated above the melting point of steel to investigate reactions between liquid steel and the ceramic material. Already before the melting of the steel DTA revealed multiple reactions. Due to a process of solid phase diffusion a second mullite phase was built and the chemical composition of the investigated steel was modified.

Figure 1 shows the calculated phase transitions in pure steel which correspond very well with the measured results (see Figure 2). It was found that the temperatures of phase transformation of the austenite (fcc) transformations and the melting of steel were shifted with the addition of the ceramic material in comparison to the pure steel sample. The bcc→fcc temperature in steel was shifted from 740°C to 931°C and the melting point of steel increased to 1521°C. This can be explained by the changed chemical composition of the steel resulted from the diffusion of alloying elements from steel into the coating material.

Phase analysis of the samples was executed employing XRD and SEM/EBSD investigations; the chemical composition of single phases was measured by SEM/EDX. A typical SEM microstructure of the sample after reaction between steel and mullite is shown in Figure 3. Only three phases were found by XRD analysis (steel, α-Al_2O_3, and mullite). In comparison to the XRD results four different phases were identified by SEM. It was shown that during the DTA experiment a second mullite phase with a different chemical composition was built. The chemical composition of one mullite was comparable to the expected ‘normal‘ mullite composition, but the second mullite was enriched by Mn, Fe and Mg. This Mn-enriched mullite phase was found to melt at 1358°C.

DTA experiments and XRD/SEM investigations proved that the described phase transformations are the result of a solid state diffusion process. In particular it was shown that the forming of the Mn-enriched mullite is not a process which needs the presence of liquid steel. The reactions would be only faster between mullite and liquid steel due to the increased diffusion velocities of the elements. It can be concluded that the observed chemical reactions between the mullite material and the steel alloy will destabilize the coating-filter interface under casting conditions. As a result an increasing oxide content in the steel melt can be expected. In addition it was shown that the amount of manganese is decreased and the amount of aluminium is slightly increased in steel. ■

EXPERIMENTS ON PARTICLE DEPOSITION FROM THE MELT

Subprojects B01 and B04 deal with the approximation and adhesion behavior of particles at a filter matrix as well as with agglomeration processes and their impact on the filter efficiency. Modelling and attendant experiments with sample liquids aid the understanding and the improvement of the metal melt filtration.

Author: Fabian Heuzeroth
(subproject B01)

High surface energies of metal melts often result in a lacking wetting behavior at various surfaces. Additionally, high casting temperatures and the opacity of metal melts have to be taken into account. Hence, in order to explore filtration mechanisms a filtration testing stand is needed.

Subproject B01 “Particle deposition from the melt - adhesion in deep filtration“ is experimentally investigating filtering mechanisms of ceramic foam filters, which have been produced by subprojects A01 and A02. To this end, a filtration testing stand has been construed which can be used for experiments with sample liquids up to 5 liters (see Figure 1). To improve the understanding of metal melt filtration, physical phenomena are in the focus of the research team. Specifically, researchers are analysing the influence of the wetting behavior on particle deposition, using an atomic force microscope (AFM) and Qicpic for dynamic image evaluation. AFM captures power-distance-dependencies between a particle and a particular substrate and thus reveals the effective particle adhesion. Based on these measures, forces can be calculated that occur during interactions between the particles and the filter surfaces. Qicpic provides details of the particle behavior in fluid environments, that is the agglomeration tendency of particles in the fluid phase. Pertaining to increased deposition rates, agglomeration is critical as larger particles show better depositioning than smaller ones.

Besides analogous experiments, subproject B04 aims at providing mathematical models of real mechanisms using methods of stochastic geometry and the calculation of agglomeration rates. Investigations include the analysis of random positions and forms of particles and their replication. One the one hand, random positions and forms result from complex particle motions within the melt, which are studied in subproject B02. On the other hand, randomness can be explained by agglomeration and adhesion processes. A main object of the studies in subproject B04 is to develop a formula that captures dependencies between the concent of inclusions, the flow, and filter geometries. This formula could be used in subproject B02 for simulating filtration processes and for improving filter structures in terms of filter efficiency and effectiveness.

Furthermore, results from subproject B04 provide valuable input to the experiments run in subproject B01 concerning model systems. More precisely, these results enable the replication of results from mathematical and physical calculations in model experiments. Comparing the results would permit both the evaluation and improvement of the model system. Subproject S03 will take care of the comparisons between results from modelling and simulation and the findings obtained from filtration tests. The ultimate goal the CRC 920 is pursuing by the end of its first program period is to understand the dominant filtration mechanism in metal melt filtration. This knowledge enables the researchers to improve filter geometry in the following program periods in such a way that in the future the purity of casted products will be significantly increased. ■

Photo: Fabian Heuzeroth inserts a filter, which was made in subproject A02, for experiments in the filtration testing stand.

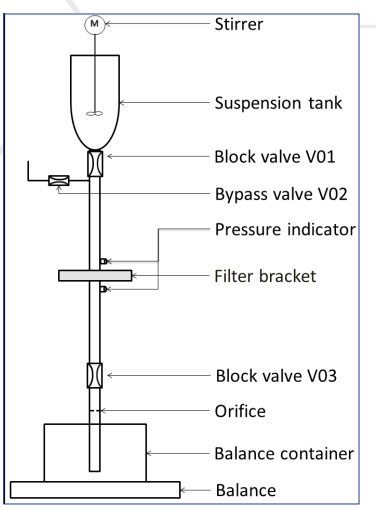


Figure 1: Schema of filtration testing stand

DOCTORAL STUDENTS' MEETINGS AND WORKSHOPS

In February 2015, reviewers of the German Research Council DFG will decide about a continuation of the CRC 920, based on the results that have been accomplished during the first program period and research activities scheduled for the second. To prepare the reviewers' visit, aims, project structures, and mutual links between the subprojects have to be adjusted.

Since 2011, researchers, doctoral students, technical staff and students from four faculties of the TU Bergakademie Freiberg jointly work on the development of novel filter materials and filter systems. With their research, CRC members aim at contributing to a significantly improved purity of metal melts, in order to elevate the quality and safety of metalic components.

Results accomplished during three years of intense research activities and detailed plans for the next four years are currently consolidated in a joint **proposal for a second program period of the CRC 920**. Until December 2014, this proposal should be submitted to the German Research Council DFG. To this end, research objectives, further publications as well as contents and methods of subsequent research projects have to be aligned. Recent members' assembly and meetings of the doctoral students were therefore dedicated to a thorough preparation and completion of this proposal.

Besides an evaluation of its scientific excellence, reviewers will also assess the CRC's concept for educating and promoting doctoral students. By establishing Integrated Graduate Programs, the DFG aims at providing structures that ensure both high-quality dissertation projects and a timely completion.

One element of the CRC's Integrated Graduate Program is the development of individual knowledge and skills referring to social competences, self-management, or communication. Ph.D. students should be enabled to share their knowledge not only with students but also with younger target groups with only limited knowledge about the subject, as for instance attendees of the Junior University or participants of courses offered at the university's School Lab.

Focusing on the definition of learning objectives, the design of lectures and teaching activities as well as options for effective examinations, a **workshop on university didactic** aimed at expanding didactic knowledge and skills. A second **workshop on individual resources management** provided approaches and instruments to explore and develop personal resources, to cope with stressfull situations, and to build up motivation so that individual goals could be successfully accomplished. ■

RECENT PUBLICATIONS

Project area A - Filter Materials

Subproject A01

Emmel, M., Aneziris, C. G. (2013): Development of active and reactive carbon-bonded filters for steel melt filtration. Proceedings of the Unified International Technical Conference on Refractories - UNITECR 2013, September 10-13, 2013, Victoria, Canada, pp. 565-570, DOI 10.1002/9781118837009.ch97.

Emmel, M., Sponza, F., Dudczig, S., Aneziris, C.G., Colombo, P. (2014): In situ Spinel Formation in Al2O3-MgO-C Filter Materials for Steel Melt Filtration. Ceramics International. Accepted: 09.05.2014, DOI: 10.1016/j.ceramint.2014.05.033.

Subproject A02

Voigt, C., Aneziris, C. G. (2013): Functional Coatings on Alumina Foam Ceramics made of Alumina for Aluminum Filtration. Proceedings of the Unified International Technical Conference on Refractories - UNITECR 2013, September 10-13, 2013, Victoria, Canada, pp.1315-1320, DOI 10.1002/9781118837009.ch222.

Voigt, C., Aneziris, C. G. (2013): Reticulated porous foam ceramics with different surface chemistries. Journal of the American Ceramic Society, Accepted: 03.04.2014; DOI 10.1111/jace.12977.

Voigt, C., Storm, J., Aneziris, C.G., Abendroth, M., Kuna, M., Hubalkova, J. (2013): The influence of the measurement parameters on the crushing strength of reticulated ceramic foams. Journal of Materials Research. Vol. 28. Iss. 17, September 14, 2013. DOI: 10.1557/jmr.2013.96, Campridge Journals Online. Copyright: Campridge University Press.

Subproject A03

Zienert, T., Fabrichnaya, O. (2013): Thermodynamic Assessment and Experiments in the system MgO-Al2O3. CALPHAD, Vol. 40, March, pp. 1–9. DOI: 10.1016/j.calphad.2012.10.001.

Zienert, T., Fabrichnaya, O. (2013): Phase relations in the A356 alloy: experimental study and thermodynamic calculations. AEM. Special Issue, 12/2013. DOI 10.1002/adem.201300113.

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.

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

Rödel, C, Weißbach, T., Kortus, J., 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., Rudolph, M., Emmel, M., Salomon, A., Aneziris, C.G., Rafaja, D. (2013): Simulations of X-ray scattering on two dimensional, graphitic and turbostratic carbon structures. Advanced Engineering Materials. Vol. 15, Iss. 12, December (2013), pp. 1280-1291. DOI 10.1002/adem.201300157

Dopita, M., Salomon, A., Emmel, M., Aneziris, C., Rafaja, D.: Microstructure of turbostratic carbon studied by X-ray scattering, Materials Structure, 20 [2] (2013), pp. 77-78. Struktura 2013.

Subproject A06

Salomon, A., Emmel, M., Dudczig, S., Rafaja, D., Aneziris, C. G. (2013): Dynamic, in situ generated interfaces between carbon-bonded alumina filters and steel during Spark Plasma Sintering/Field Assisted Sintering. AEM. Special Issue, 12/2013. DOI 10.1002/adem.201300119.

Salomon, A., Zienert, T., Voigt, C., Jäckel, E., Fabrichnaya, O., Rafaja, D., Aneziris, C. G. (2013): Comparison of interfacial reactions between AlSi7Mg and alumina filter after casting and Spark Plasma Sintering. AEM. Special Issue, 12/2013. DOI 10.1002/adem.201300114.

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“, 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: 03.0.6.2014, Manuscript-ID: PARTIC-D-1400093R1.

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.

Subproject B03

Vijay, D., Goetze, P., Wulf, R., Gross, U.: Volumetric heat transfer determination for forced convection of air through alumina (Al2O3) foam. 15th International Heat Transfer Conference (IHTC-15), August 10-15, 2014, Kyoto, Japan. Manuscript-ID: IHTC15-9167, accepted: 27.03.2014.

Götze, P., Vijay, D., Jäckel, E., Wulf, R., Gross, U.: Experimental Determination of Convective Heat Transfer Coefficients During Molten Aluminum Purification Using Open-Cell Alumina (Al2O3) Ceramics. 15th International Heat Transfer Conference (IHTC-15), August 10-15, 2014, Kyoto, Japan. Manuscript-ID: IHTC15-9167, accepted: 31.03.2014.

Subproject B04

Fritzsche, J., Peuker, U.A.: The influence of particle agglomeration on the filtration efficiency of ceramic foam filters. FILTECH 2013, October 22-24, 2013, Wiesbaden, Germany. Paper-No: P126. Filtech 2013.

Subproject B05

Storm, J., Abendroth, M, Zhang, D., Kuna, M. (2013): Geometry dependent effective elastic properties of open-cell foams based on Kelvin cell models. AEM. Special Issue, 12/2013. DOI 10.1002/adem.201300141.

Storm, J., Abendroth, M., Kuna, M. (2013): Geometry dependent effective heat conductivity of open-cell foams based on Kelvin cell models. Proceedings of the Unified International Technical Conference on Refractories - UNITECR 2013, September, 2013, Victoria, Canada, pp. 897-902, DOI 10.1002/9781118837009.ch153.

Project area C - Filter performance, materials properties

Subproject C01

Aneziris, C. G., Roungos, V., Dudczig, S., Emmel, M. (2013): Refractories with Improved Thermal Shock Performance Serving Low Carbon Economy. China‘s Refractories, Vol. 22, No. 3, pp. 7-11. ISSN 1004-4493/CN41-1183.

Dudczig, S., Aneziris, C. G., Dopita, M., Raja, D. (2013): Application of oxide coatings for improved steel filtration with the aid of a metal casting simulator. AEM. Special Issue, 12/2013. DOI 10.1002/adem.201300121.

Werner, J., Dudczig, S., Aneziris, C. G. (2013): Young's modulus of elasticity of carbon bonded alumina materials up to 1250°C. J. Am. Ceram. Soc., Vol. 96, Iss. 9, September (2013), pp. 2958-2965. DOI 10.1111/jace.12526.

Werner, J., Aneziris, C. G. (2013): Contribution of Different Binder Systems to Young's Modulus of Elasticity of Carbon-Bonded Alumina at elevated Temperatures. Proceedings of the Unified International Technical Conference on Refractories - UNITECR 2013, September 10-13, 2013, Victoria, Canada, pp. 147-152, DOI 10.1002/9781118837009.ch26.

Subproject C02

Klemm, Y., Biermann, H., Aneziris, C. G. (2013): Microstructure and mechanical properties of fine grained carbon-bonded Al2O3-C materials. Ceramics International. Vol. 39, Iss. 6, August (2013), pp. 6695-6702. DOI: 10.1016/j.ceramint.2013.01.108.

Klemm, Y., Biermann, H., Aneziris, C. G. (2013): Different Fabrication Routes for Carbon-Bonded Al2O3-C and their Influence on the Physical and Mechanical Properties. Proceedings of the Unified International Technical Conference on Refractories - UNITECR 2013, September 10-13, 2013, Victoria, Canada, pp. 591-596, DOI 10.1002/9781118837009.ch102.

Subproject C03

Soltysiak, S., Abendroth, Kuna, M., Klemm, Y., Biermann, H. (2014): Strength of fine grained carbon-bonded alumina (Al2O3-C) materials obtained by means of the small punch test. Ceramics International. DOI 10.1016/j.ceramint.2014.02.030.

Soltysiak, S., Abendroth, M., Kuna, M. (2013): Influence of the Carbores content on the strength of carbon bonded alumina obtained by means of Small Punch Test. Proceedings of the Unified International Technical Conference on Refractories - UNITECR 13, September 10-13, 2013, Victoria, Canada, pp. 135-140, DOI: 10.1002/9781118837009.ch24.

Subproject C04

Krewerth, D., Weidner, A., Biermann, H.(2013): Application of In Situ Thermography for Evaluating the High-Cycle and Very High-Cycle Fatigue Behaviour of Cast Aluminium Alloy AlSi7Mg (T6). Ultrasonics Journal, Vol. 53. Iss. 8, December 2013, pp. 1441–1449. DOI: 10.1016/j.ultras.2013.03.001.

Krewerth, D., Weidner, A., Biermann, H.: A comparative study on infrared thermography during ultrasonic fatigue testing of cast steel 42CrMo4 and cast aluminium alloy AlSi7Mg. Key Engineering Materials, 592-593 (2014), 501-504.

Subproject C05

Henschel, S., Krewerth, D., Ballani, F., Weidner, A., Krüger, L., Biermann, H., Emmel, M., Aneziris, C. G. (2013): Effect of filter coating on the quasi-static and cyclic mechanical properties of a G42CrMo4 casting. Advanced Engineering Materials. Vol. 15, Iss. 12, December (2013), pp. 1216-1223. DOI 10.1002/adem.201300125

Complementary subprojects

Subproject S02

Lehmann, H., Werzner, E., Mendes, M., Trimis, D., Jung, B. (2013): In-situ data compression algorithm for detailed numerical simulation of liquid metal filtration through foam-like structures. Advanced Engineering Materials. Vol. 15, Iss. 12, December (2013), pp. 1260-1269. DOI 10.1002/adem.201300129.

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.

Patents granted

Subproject A01

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

Subproject C01

Aneziris, C. G.; Dudczig, S., Emmel, M.: keramische Filter für die Metallschmelzfiltration auf der Grundlage gängiger Metallschmelze-Filtergeometrien und Verfahren zu ihrer Herstellung, DE 102011109681 A1, Patenterteilung: 28.03.2014.

CONFERENCES AND CALLS FOR PAPERS

5th International Conference on Porous Media and Their Applications in Science, Engineering and Industry, June 22-27, 2014, Kona, Hawaii, USA: Further informationen available at http://http://www.engconf.org/conferences.

MSE 2014 - Materials Science and Engineering Congress, September 23-25, 2014, Darmstadt: Further informationen available at http://http://www.dgm.de/dgm/mse-congress/.

CellMAT 2014, October 22-24, 2014, Dresden: Further informationen available at http://www.dgm.de/dgm/cellmat/.

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.

IMPRESSUM

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

ISSUE: No. 6, Issue 02/2014
(two issues per year)

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