SFB 920

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

NEWSLETTER 10 (1/2016)

DFG Deutsche Forschungsgemeinschaft

TECHNISCHE UNIVERSITÄT BERGAKADEMIE FREIBERG

DEAR READERS,

Currently, research on efficient filter structures and -systems is gaining valuabe support from an international expert for cellular materials, especially porous and polymer-derived ceramics: For six month, Professor Paolo Colombo from the Univerità di Padova/Italy is visiting the CRC team as a Mercator Fellow. The CRC 920 benefits from his visit in multiple ways, including productive discussions, collaborative investigations and teaching activities targeted at undergraduates and doctoral students.

Moreover, the CRC 920 successfully established a first transfer project. In cooperation with the industry, ceramic filter components produced in the CRC are applied in continuous casting experiments, in order to test relevant materials properties and behaviors under realistic conditions.

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

NEW SUBPROJECT AND FIRST TRANSFER PROJECT WITH THE INDUSTRY LAUNCHED

On May 23rd, 2016, the German Research Foundation DFG approved the first transfer project of the CRC 920 "Multi-Functional Filters for Metal Melt Filtration - A Contribution towards Zero Defect Materials." This project aims at investigating how to increase the cleanliness of liquid steel. To this end, the CRC 920 collaborates with the industry: ThyssenKrupp Steel Europe AG serves as research partner.

The scientific subprojects involved in the CRC 920 have been complemented by a **new subproject A07**. This new project explores the applicability of filters developed in the CRC for reducing the iron content from secondary aluminum melts by eliminating primary solidified, iron-containing, intermetallic phases. To accomplish this aim, the influence of alloy composition and temperature on the primary precipitation process is evaluated using the Calphad method to find out how to optimize the alloy's composition for Fe-removal by adding further elements. Special emphasis is given to the analytical identification of the intermetallics, possible chemical interactions between the phases and the filter as well as to actual filtration experiments. **Professor Andreas Leineweber, Professor for Applied Materials Science** at the Faculty of Materials Science and Engineering, serves as the new project's coordinator.

Moreover, the German Research Foundation DFG approved a joint transfer project of the CRC 920 and an industrial partner. "The transfer project T01 focuses on the application of novel, changeable filter systems in continuous casting of aluminum-killed steel (tinplate steel), in order to eliminate non-metallic inclusions from aluminum melts," explains Professor Aneziris. Reliability of metallic components often refers to material properties such as strength and toughness. Both properties, however, strongly depend on the materials cleanliness, defined by the frequency, size distribution, morphology and chemical properties of so-called non-metallic inclusions. Inadmissible contents of non-metallic conclusions are able to diminish relevant properties of security components, thin- and thick-walled cast components or forged elements such as strength, toughness, fatigue resistance, or notch impact strength.

The transfer project produces filter components based on the filter materials developed in the CRC 920. Besides the characterization of the filter components before and after continuous casting and the identification of the purity level of the steel melt, numerical simulations will be employed to discover interdependencies between filter structures, melt streams and inclusions with regard to the precipitation of non-metallic inclusions at the filter surface.

ThyssenKrupp Steel Europe AG in Duisburg will be conducting experiments in continuous casting using a 86 t tundish. The ceramic filter components will be produced and characterized at the Institute of Ceramics, Glass and Construction Materials with **Professor Christos G. Aneziris. Professor Rüdiger Schwarze,** Institute for Mechanics and Fluid Dynamics will be in charge for the numerical analyzes.

ThyssenKrupp Steel Europe (TKSE) is one of the world-leading suppliers of high-quality flat steel. With its approximately 27,000 employees, TKSE provides high-performance steel products for innovative and demanding applications in various industries. TKSE offers a range of services including customer-specific material solutions and services associated with the material steel. The company supplies the automotive industry, machinery and plant engineering, the packaging industry and the energy sector. ThyssenKrupp Steel Europe addresses increasing demands for increasingly efficient lightweight construction and safety standards, researches and develops new high-tech steels and defines standards for surface and processing technologies. ■

MORE NEWS

MERCATOR FELLOW VISITING THE CRC 920

From February 2016, **Professor Paolo Colombo** from the Università di Padova/Italy will be visiting TU Bergakademie Freiberg as a **Mercator Fellow**. During his visit, he will be offering various lectures and workshops, among others on "Additive Manufacturing of Ceramics using Inorganic Polymers."

Professor Colombo is a professional expert on cellular materials, especially on porous and polymer-derived ceramics. His research interests include novel processing routes to porous glasses and ceramics, the development of ceramic components from preceramic polymers and the vitrification and reuse of hazardous industrial and natural waste.

The German Research Foundation DFG offers Mercator Fellowships in order to enhance intensive, long-term project-based collaboration between researchers from both domestic and foreign institutions. Although Mercator Fellows are on-site for only part of the project, they remain in contact with the project team members once their research stay is over. ■

Photo: Prof. Dr. Paolo Colombo

INTERNATIONAL SPRING SCHOOL

In May 2016, the **"International Spring School of AGH Krakow and CRC 920"** took place. Invited by the CRC 920, researchers from the Department of Ceramics and Refractory Materials from Akademia Górniczo-Hutnicza (AGH) Krakow in Poland, under direction of **Professor Jacek Szczerba**, visited TU Bergakademie Freiberg between May 23rd and 24th. The joint event was entitled "Design and Application of Refractory Materials."

The event was opened with presentations from the international guests. Afterwards, a tour through the Institute of Ceramics, Glass and Construction Materials was offered. On the second day, doctoral students of the CRC 920 presented their projects and research findings pertaining to the development of innovative filter materials, the modeling of filter structures and systems as well as the identification of filter efficiencies and relevant materials properties.

Professor Jacek Szczerba sent an official note to thank Professor Christos G. Aneziris for the intensive academic dialogue. Both partners were looking forward to a collaboration in the field of refractory materials and their industrial applications in the future. ■

Photo: Prof. Aneziris (right) and Prof. Szczerba (second from right) coordinated the "International Spring School of AGH Krakow and CRC 920."

WORKSHOP ON STEEL PRODUCTION

In May 2016, Ph.D. students, project coordinators and members of the CRC 920 were invited to a workshop on steel production, offered by the Salzgitter Flachstahl GmbH in Salzgitter. The ultimate objective was to provide advanced information and training to all CRC members in the field of flat steel production.

The workshop, a field trip to an automotive company as well as a direct exchange of information and experiences aimed at facilitating mutual collaboration between the CRC's subprojects. Workshop presentations were given by **Dipl.-Ing. Jens Pischke and Dr.-Ing. Annika Mertke** (both with Salzgitter Flachstahl GmbH) as well as **Dipl.-Ing. Steffen Dudczig and Dipl.-Ing. Anne Schmidt** (both doctoral students in the CRC 920). ■

SALZGITTER AG
Stahl und Technologie

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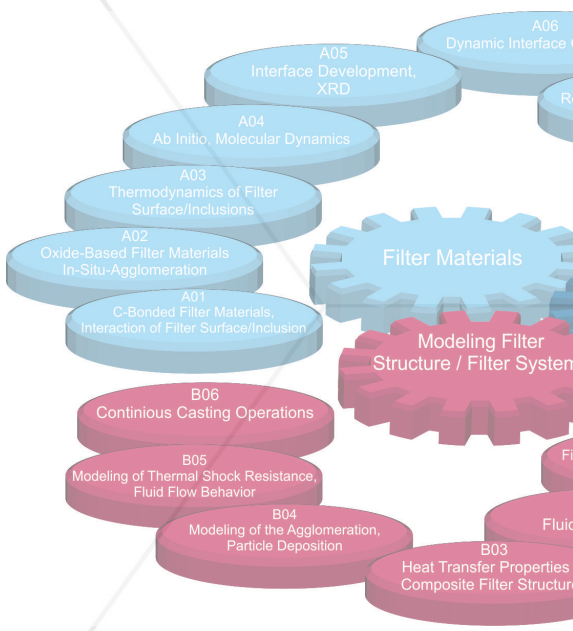
WORKING GROUPS' REPORT

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.

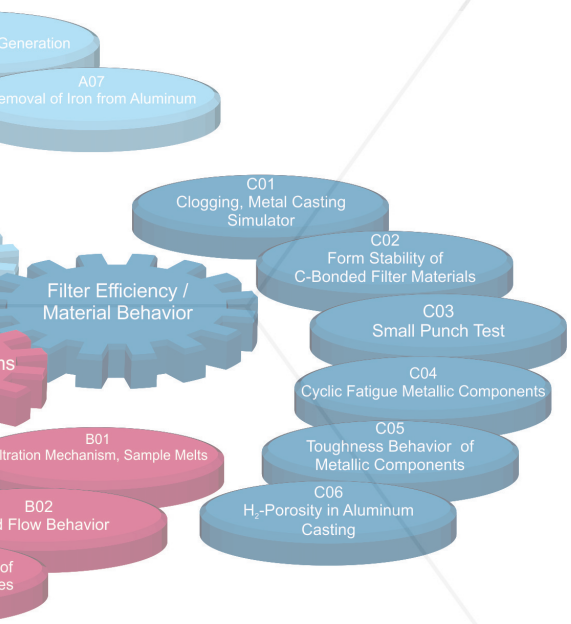
Working Group 1: "Metal melt/inclusions, active/reactive filter materials, boundary surface design" (Coordination: Dipl.-Ing. Tilo Zienert)

- Investigation of the influence of carbon on the reactions between Al_2O_3-C coatings with liquid steel; studies on the kinetic of the interface reaction in "finger" test with different holding times between 10 and 120 seconds (A01),
- Developement of preliminary thermodynamic datasets for the calculation of interface reactions between liquid aluminium and Al_2O_3-TiO_2-ZrO_2 filter materials; determination of heat capacities of intermetallic phases $FeAl_2$, Fe_2Al_5 and Fe_4Al_{13} between -120 °C and the respective melting points (A03),
- Structural investigations of intermediary aluminium oxides accompanying the thermally induced transition from boehmite to corundum, with special regard to their thermal stability (A05),
- Analysis of the stability of metastable Al_2O_3-phases under reducing working conditions or in contact with molten alloy AlSi7Mg; production and experimental testing of an alternative sintering tool made of ZrB_2; first investigations of interfacial reactions after contact of carbon-bonded, corundum-based filter structures with molten 42CrMo4 steel (A06),
- Investigation of the influence of roughness on adhesion forces in the model system with samples of A01 and A02 (B01),
- Experiments on prismatic samples for the investigation of kinetics in the steel-cast-simulator together with Prof. P. Colombo and A01; developement and tests of new experimental methods for further investihations in the casting simulator (C01),
- Investigations on the reactivity of hydrogen with pure spodumen and spodumen-alumina mixtures; proof of hydrogen in the reaction products by SNMS; quantitative analysis will be done as next step. (C06).



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

- Verification of the functionality of HT-CP-cantilevers by measuring capillary forces and testing of the first crucible-prototype for the application in the HT-AFM with a poor wetting liquid (B01),
- Development and construction of a micro bubble generator using the DESM (Dynamically Enhanced Static Membrane) principle for heteroagglomeration of hydrophobic alumina particles and microbubbles at room temperature (B04),
- Trials for the determination of process parameters ensuring a repeatable measurement of the volumetric heat transfer coefficient during casting tests as well as improvement of the test facility for visualization of the melt-gas interface and measurement of permeability (B03),
- Generation of foam structures with varied geometric properties and investigation of their thermomechanical behavior by means of LBM and FEM simulations (B05, B02),
- Numerical investigation of the melt flow and filtration inside the steel casting simulator considering effective properties of the filters obtained from pore-scale simulations (B06, B02, C01, A01),
- Permanent integration of the compression library developed by S02 into the simulation code of B02 and performance testing on high-performance computers in Freiberg and Dresden.



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

- Processing of cast steel 18CrNi-Mo7-6 from crucible reaction test in metal melt casting simulator. Received results should be fundamentally for development of new coatings. (C01, C04, C05, S01),
- Processing of cast steel 42CrMo4 (2. phase) from finger test investigations in metal melt casting simulator with varied reaction period and application of uncoated and CNT-coated Al_2O_3-C-filters (A01, C01, C04, C05, S01),
- Advancement of preparation techniques for microstructure and inclusion investigation as well as non-metallic inclusion cluster formation characterization (C04, S01),
- Investigations on two selected filters showed an advanced filtration behavior for coating with alumina, especially for small endogenous inclusions. The three-dimensional morphology, exposed by deep etching, exhibits a great variety of inclusion shapes from globular, vermicular individual inclusions up to coral-like structures of inclusions clusters, which is the result of the sintering process during the solidification of the steel melt. (A01, C04, S01),
- Design of aluminum cast tests in cooperation with Hydro Aluminum, where LiMCA and PoDFA devices are included in test rig. The experiments will be performed in order to investigate the influence of i) filter surface roughness (09/2016) and ii) filter material (02/2017) on the filtration of non-metallic inclusions. The cast material will be investigated in terms of inclusion formation kinetics and properties of the filtered material. (A02, C04, C05, S01, S02).

Working Group 3: "Thermo-mechanical characteristics of filter materials and structures" (Coordination: M. Sc. Henry Zielke)

- Analysis of the filter after immersion test at steel casting simulator: comparison of Al_2O_3-coating with low carbon content (4ma%) and pure Al_2O_3 coating at different immersion times to describe the kinetics (A01),
- Deducting of elastic properties out of experimental data of C02 and applying to artificial generated foams to model foam pressure tests (B05),
- Determining of the pressure distribution of aluminum melt, which is flowing through a computer generated foam in cooperation with subproject B02, which calculates temperature and flow field (B05),
- Investigation of the influence of the specimen manufacturing process on the thermomechanical properties (C03),
- Implementation of acoustical emission to the experimental procedure (C02),
- Testing of filter structures due to mechanical properties at high temperatures (C02),
- Calculative verification of comparability between experimental effective compressive strength of the filter (C02) and Weibull strength obtained with the small punch test (C03) by using a Kelvin cell model.

ANALYSIS OF PARTICLES-SURFACES INTERACTION EFFECTS

Author: Lisa Ditscherlein
(Subproject B01)

Subproject B01 investigates the processing of particle precipitation and adhesion in technical filter structures. The project centers on sintering between particles and the filter surface as well as on capillary bonds through micro and meso bubbles as a further mechanism to affect adhesion.

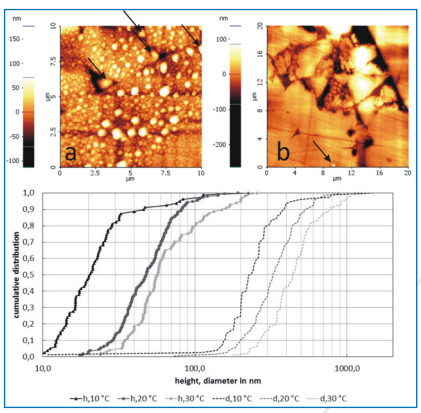


Fig. 1: Topographic images of a hydrophobic alumina surface with nanobubbles (a) and a hydrophilic surface (b) as well as height and diameter distributions under variation of substrate temperature on hydrophobic Al_2O_3.

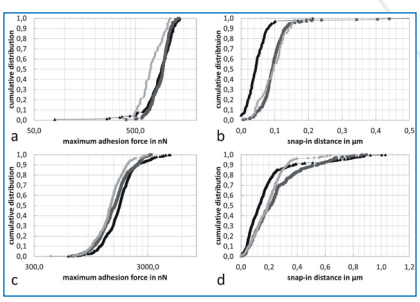


Fig. 2: Adhesion force (a) and snap-in distance distributions (b) on hydrophilic and hydrophobic (c,d) Al_2O_3 surfaces with substrate temperatures of 10 °C (triangles), 20 °C (squares) and 30 °C (diamonds).

In subproject B01 an AFM-investigation of the formation, size and force distribution as well as the stability of nanoscopic cap shaped bubbles on hydrophilic and hydrophobic alumina in water is done. It can be assumed that bubbles on the filter surface contribute to an increasing of adhesive forces and so promote the particle deposition during filtration.

For all investigations demineralized water is heated. Owing to a gas supersaturation, bubbles especially in asperities and pores on poor wetting alumina are generated after formation of a water depletion layer (dense gas layer). The bubbles cover nearly the entire substrate surface with heights < 260 nm and diameters < 1500 nm (Figure 1). A temperature dependency of the bubble sizes is observed. In contrast to that there are only a few bubbles on hydrophilic alumina detectable, mainly in pores. Despite high gas supersaturation, a bubble creation is energetically unfavorable on good wetting surfaces. The reason for the detection of bubbles in pores is suspected by terms of line pinning.

In addition to topographic images force measurements with colloidal probe-AFM were done. While forces on hydrophilic alumina are narrowly distributed between 380-1330 nN, forces on hydrophobic substrates are much higher and widely distributed (640-4730 nN). This behavior is caused by the size variation of the bubbles, since small bubbles induce moderate capillary forces while large ones high forces. Interestingly, there is an inverse temperature dependency contrary to results of topographic imaging. This behavior is also reflected in distributions of snap-in distances which are equated as nanobubble heights: The snap-ins on hydrophobic surfaces have distances up to 1100 nm without significant influence of temperature, inconsistent with topographic images. It is assumed that after some time bubbles will detach and adhere on the particle due to the high degree of bubble coverage, whereby a detection of temperature influence is impede. Therefore, as a result of capillary bridges between bubbles on both substrate and particle surface, high adhesion forces are detected. For comparison, many force measurements on hydrophilic alumina surfaces were done to get a statistically robust number of force distance curves with snap-ins (bubble heights). These distributions match very well with typical heights of topographically detected nanobubbles, also the temperature influence is observed. This contributes the assumption of a bubble on the colloidal probe (Figure 2).

A detection of bubbles on even rougher Al_2O_3-surfaces is challenging, because bubbles cannot be clearly distinguished from small particles. Hence, two phase contrast images of the cantilever movement are used for minimization of height effects so that a differentiation between soft (bubbles) and hard matter (alumina particle) is possible. Scanning the sample surface by using a contact force of 40 nN shows, that bubbles only remain stable in asperities but not on smooth parts. So, for metal melt filtration the adaption of the filter surface seems to be an important factor for increasing the efficiency. ■

Ditscherlein, L., Fritzsche, J., Peuker, U. A.: Study of nanobubbles on hydrophilic and hydrophobic alumina surfaces, Colloids and Surfaces A: Physicochemical and Engineering Aspects 497 (2016), 242-250.

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Multifunktionale Filter für die Metallschmelzefiltration –
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IMPACT OF WETTING PROPERTIES ON ADHESION BETWEEN PRIMARY PARTICLES

Subproject B04 is dealing with the agglomeration behaviour of the particle impurities. It aims to create agglomerates which can be separated with an high efficiency during the subsequent filtration step. By this, subproject B04 makes a significant contribution to fulfil the high expectations of the filtration process.

Author: Jörg Fritzsche
(Subproject B04)

To understand the creation as well as the stability of the agglomerates a knowledge of the adhesive forces between the primary particles is of importance. Thereby, the wetting behavior of the melt plays a major role. The Contact angles between the ceramic surfaces and the molten metals are very high due to the high surface tension of the melt. Caused by this behavior, the study aims to investigate the influence of wetting on the adhesive forces with aid of a model system at ambient temperature.

Experimentel investigation are carries out by using the atomic force microscope in combination with the colloidal probe technique. The results show that adhesive forces as well as the mechanism of the adhesive forces are influenced by the wetting behaviour. Of particular importance are nano scaled bubbles at the ceramic surfaces. Due to these so called nanobubbles capillary forces causes of a gaseouse capillary bridge at particle contact becomes possible. By this, the adhesive forces can be increased significantly. As illustrated in Figure 1a, adhesive forces between particles are about two times higher if a capillary bridge can be detected compared to an interaction without a capillary bridge. Furhermore, Figure 1b shows the indluence of the wetting bahviour on the acting force mechanism. As shown, the propability of capillary bridging is decreased by better wetting. The destinction between capillary and non-capillary forces is done by a MATLAB routine based on the measured force vs. distance curves obtained by the AFM. For instance capillary forces show a high snap-in distance during the trace as well as a step-like behaviour during the ratrace of the colloidal probe [2, 3].

Further progress is made by the modelling of the measured adhesive forces. If the adhesive forces are based on van der Waals-forces a model to describe the distribution of the adhesive forces is developed. If the *rms*-roughness of the surfaces are known, a prediction of the expected force distribution of possible. As shown in Figure 2 this is valid for the range as well as the absolute values of the forces. Minor deviations between the modelled and measured forces are only at very low and very high probabilities. Due to the fact, that the model is based on simple geometries a transferability to other surface forces is possible [1].

By combining the probability of the different acting force mechanism with the distributions of the forces a prediction of the adhesive forces between the particles becomes possible. In association with the modelled stream lines from the subprojects B02 and B06 and investigation in tailoring agglomerates with a defined size and structure can be done. ■

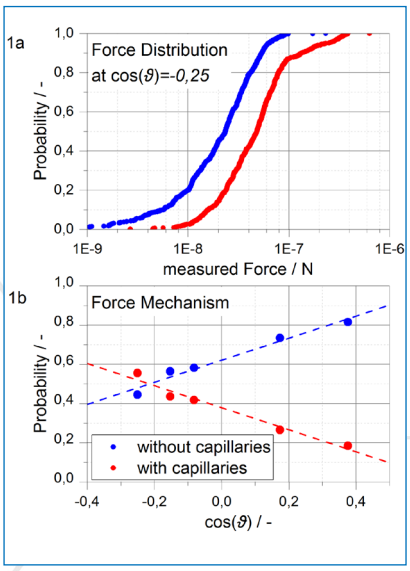

Fig. 1: Distribution of the measured adhesive forces divided in force mechanisms (above) and the probability of the acting mechanisms (below) [2, 3].

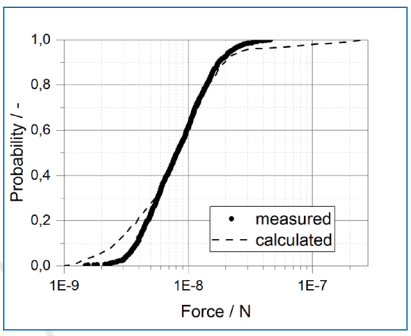

Fig. 2: Measured and modelled adhesive force distributions [1].

Literature:
[1] J. Fritzsche, U. A. Peuker, Powder Technol. 2016, 289, 8.
[2] J. Fritzsche, U. A. Peuker, Colloids Surf., A 2014, 459, 166.
[3] J. Fritzsche, U. A. Peuker, Procedia Engineering 2015, 102, 45.

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RECENT PUBLICATIONS

Project area A - Filter materials

Subproject A01

Schmidt, A., Hubálková, J., Gehre, P., Aneziris, C. G. (2016): The impact of the carbon content on the properties of carbon-bonded alumina filters for steel melt filtration. 91. DKG Annual Conference and Symposium on High-Performance Ceramics 2016, 07.03.-09.03.2016, TU Bergakademie Freiberg.

Storti, E., Dudczig, S., Emmel, M., Colombo, P., Aneziris, C. G. (2016): Functional Coatings on Carbon-Bonded Ceramic Foam Filters for Steel Melt Filtration. steel research international, accepted: 07.01.2016, DOI 10.1002/srin.201500446.

Storti, E., Roso, M., Modesti, M., Aneziris, C. G., Colombo, P. (2016): Preparation and morphology of magnesium borate fibers via electrospinning. Journal of the European Ceramic Society, Vol. 36 (2016), pp. 2593-2599, DOI 10.1016/j.jeurceramsoc.2016.02.049.

Storti, E., Dudczig, S., Schmidt, G., Colombo, P., Aneziris, C. G. (2015): Short-time performance of MWCNTs-coated Al_2O_3-C filters in a steel melt. Journal of the European Ceramic Society, Vol. 36, Iss. 3, February 2016, pp 857–866, DOI 10.1016/j.jeurceramsoc.2015.10.036.

Subproject A02

Le Brun, P., Taina, F., Voigt, C., Jäckel, E., Aneziris, C. G. (2016): Assessment of Active Filters for High Quality Aluminium Cast Products, 2016 TMS Annual Meeting & Exhibition, Symposium: Cast Shop Technology, February 14-18, 2016, Nashville, TN, USA, in: Light Metals 2016 (ed E. Williams), John Wiley & Sons, Inc., Hoboken, NJ, USA. DOI 10.1002/9781119274780.ch133.

Sarkar, N., Park, J. G., Mazumder, S., Aneziris, C. G., Kim, I.J. (2015): Processing of particle stabilized Al_2TiO_5-$ZrTiO_4$ foam to porous ceramics. Journal of the European Ceramic Society, Vol. 35, Iss. 14, November 2015, pp. 3969-3976, DOI 10.1016/j.jeurceramsoc.2015.07.004.

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, June 2015, 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): Influence of amphiphile on foam stability of Al_2O_3-SiO_2 colloidal suspension to porous ceramics. Journal of Ceramic Processing Research, Vol. 16, Iss. 4, 14. September 2015, pp. 392-396.

Voigt, C., Aneziris, C. G. (2016): Ceramic foam filter for the filtration of aluminum with different surface chemistrie. ICACC 2016 - 40th International Conference and Expo on Advanced Ceramics and Composites, 24.-29. January 2016, Daytona Beach, USA, Abstract-ID: 2455741.

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, Vol. 98, Iss. 5, pp. 1460-1463, DOI 10.1111/jace.13522.

Subproject A03

Dreval, L., Zienert, T., Fabrichnaya, O. (2015): Calculated phase diagrams and thermodynamic properties of the Al_2O_3-Fe_2O_3-FeO system. Journal of Alloys and Compounds, Vol. 657, 5 February 2016, pp. 192-214, DOI 10.1016/j.jallcom.2015.10.017.

Subproject A04

Amirkhanyan, L., Kortus, J. (2016): First principles investigations on intermetallic ϵ-Al_5Fe_2 phase. Verhandlungen der Deutschen Physikalischen Gesellschaft, Regensburg 2016, 06.-11.03.2016, Vortrag MM 35.4.

Project area B - Modeling of filter structures/ filter systems

Subproject B01

(2016): Study of nanobubbles on hydrophilic and hydrophobic alumina surfaces. Colloids and Surfaces A: Physicochem. Eng. Aspects, Vol. 497 (2016), pp. 242–250, DOI 10.1016/j.colsurfa.2016.03.011.

Heuzeroth, F., Fritzsche, J., Werzner, E., Mendes, M. A. A., Peuker, U. A., Ray, S., Trimis, D. (2015): Viscous force - An important parameter for the modelling of deep bed filtration in liquid media. Powder Technology, Vol. 283, October 2015, pp. 190-198. DOI 10.1016/j.powtec.2015.05.018.

Peuker, U. A., Heuzeroth, F., Fritzsche, J., Werzner, E., Mendes, M., Trimis, D., Ray, S. (2016): Depth Filtration in Liquid Media - A New Approach to Estimate the Filtration Efficiency Based on the Calculated Impact and Measured Adhesion Probability. 12th World Filtration Congress - WFC 12, April 11-15, 2016, Taipei, Taiwan.

Subproject B02

Mendes, M., Roessger, P., Gross, U., Wulf, R., Trimis, D., Ray, S., Goetze, P., Talukdar, P., Werzner, E., Demuth, C. (2016): Measurement and simplified numerical prediction of effective thermal conductivity of open-cell ceramic foams at high temperature. International Journal of Heat and Mass Transfer, accepted: 08.06.2016, DOI 10.10.

Subproject B03

Vijay, D., Goetze, P., Wulf, R., Gross, U. (2015): Forced convection through open cell foams based on homogenization approach: Steady state analysis, International Journal of Thermal Science, Vol. 98, December 2015, pp. 381–394, DOI 10.1016/j.ijthermalsci.2015.07.017.

Vijay, D., Goetze, P., Wulf, R., Gross, U. (2015): Forced convection through open cell foams based on homogenization approach: Transient analysis, International Journal of Thermal Science,Vol. 98, December 2015, pp. 395–408, DOI 10.1016/j.ijthermalsci.2015.07.013.

Subproject B04

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Knüpfer, P., Fritzsche. J., Peuker, U.A. (2016): Bestimmung von Wechselwirkungen an Fluid-Fluid-Grenzflächen mittels Rasterkraftmikroskopie. Jahrestreffen der ProcessNet-Fachgruppen „Extraktion und Grenzflächenbestimmte Systeme und Prozesse“, 14. - 15. März 2016, Weimar, Vortrag-Nr. 2945.

Subproject B05

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Settgast, C., Abendroth, M., Kuna, M. (2016): Bruchmechanische Analyse von offenzelligen keramischen Schäumen, Fracture mechanical analysis of open cell ceramic foams. 48. Tagung des DVM-Arbeitskreises Bruchvorgänge und Bauteilsicherheit, 16.-17.02.2016, DVM-Bericht 248 (2016), pp. 51-60, ISSN 2366-4797.

Storm, J., Abendroth, M., Kuna, M. (2016): Numerical and analytical solutions for anisotropic yield surfaces of the open-cell Kelvin foam. International Journal of Mechanical Sciences, Vol. 105, pp. 70-82, January 2016, DOI 10.1013/j.ijmecsci.2015.10.014.

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, Juli 2015, pp. 1-10, DOI 10.1016/j.mechmat.2015.02.012.

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Subproject B06

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Project area C - Filter performance, materials properties

Subproject C01

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Subproject C03

Bestimmung der bruch- und schädigungsmechanischen Eigenschaften keramischer Filterwerkstoffe aus Kleinstproben, Determination of fracture and damage mechanical properties of ceramic filter materials using miniaturized specimens. 48. Tagung des DVM-Arbeitskreises Bruchvorgänge und Bauteilsicherheit, 16.-17.02.2016, DVM-Bericht 248 (2016), pp. 61-70, ISSN 2366-4797.

Subproject C04

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Subproject C05

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Henschel, S., Krüger, L. (2015): Dynamic crack initiation measurements in a four-point split Hopkinson bending device. Engineering Fracture Mechanics, Vol. 133, Jannuary-December 2015, pp. 62–75, DOI 10.1016/j.engfracmech.2015.05.020.

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Henschel, S., Krüger, L. (2016): Modelling of crack initiation in a G42CrMo4 steel with non-metallic inclusions. Steel Research International, Vol. 87, Iss. 1, 2016, pp. 29-36, DOI 10.1002/srin.201400567.

Krüger, L., Ehinger, D., Henschel, S. (2016): Festigkeits-, Verformungs- und Versagensverhalten ausgewählter Werkstoffe bei unterschiedlichen Beanspruchungsgeschwindigkeiten. In: U. Groß (Ed.): Glanzlichter der Forschung an der TU Bergakademie Freiberg – 250 Jahre nach ihrer Gründung. Chemnitz: Chemnitzer Verlag, S. 247–255, ISBN 978-3-944509-26-6.

Complementary subprojects

Subproject S01

Moritz, K., Ballaschk, U., Schmidt, G., Hubalkova, J., Aneziris, C. G. (2015): Oxide ceramics with unidirectional pore channels by electrophoretic deposition. Journal of the European Ceramic Society, Vol. 36, Iss. 2, January 2016, pp. 333-341, DOI 10.1016/j.jeurceramsoc.2015.07.006.

Subproject S02

Lehmann, H., Werzner, E., Degenkolb, C., Ray, S., Jung, B. (2016): Optimizing In-Situ Data Compression for Large-Scale Scientific Simulations. 24th High Performance Computing Symposium, Spring Simulation Multi-Conference (HPC/Spring Sim 2016), April 3 - 6, 2016, Pasadena, CA, USA.

SUCCESSFUL PH.D. DEFENSE

On May 30th, Dipl.-Ing. Claudia Voigt successfully defended her doctoral dissertation entitled **"Surface Functionalization of Ceramic Foam Filters for Aluminum Melt Filtration."** In her thesis, Claudia Voigt employed two independent experiments to analyze filters with five different oxidic surface chemicals with regard to their filter performance. Her work contributes to a better understanding of the impact of filter materials on filtration efficiency.

Photo: Claudia Voigt (middle), Prof. Gotthard Wolf (left) and Prof. Christos G. Aneziris (right).

Claudia Voigt has presented her findings on several occasions, including the world's largest conference in ceramics - the ICACC in the USA. She was the only young scientist from Germany who received one of the rare travel grants funded by the European Ceramic Society, which permitted attending the **ACers Winter Workshop** of the American Ceramic Society. ■

DKG ANNUAL MEETING

In March 2016, TU Bergakademie Freiberg hosted the Annual Meeting of the German Ceramic Association DKG with 320 attendees from 14 nations. Entitled "Material of Mankind", the conference offered several parallel sessions on current research topics, ranging from functional ceramics to high-performance ceramics and processing technologies and additive manufacturing, with a focus on both basic research and industrial applications.

In several keynotes international experts presented the state of the art of contemporary ceramics research. Among them were **Professor Peter Greil from Erlangen-Nuremberg University, awardee of the Leibniz Price**, Professor Aldo R. Boccaccini, also Erlangen-Nuremberg University and one of the most often cited researchers in this field, Professor Thomas Graule from EMPA Switzerland, Dr. Michal Přibyl, President of the Czech Silicate Association, and Professor Pavol Šajgalík, President of the Slovakian Academy of Sciences IAP.

After the conference participants enjoyed a reception at the "terra mineralia" exhibition and a social evening in the Tivoli Concert Hall. On this occasion, several researchers received honors for their outstanding scientific work. ■

CONFERENCES AND CALLS FOR PAPERS

6th International Congress on Ceramics - ICC6: 21.-25.08.2016, Dresden, further information available at: http://www.icc-6.com.

International Spring School of UFSCar Sao Paulo and CRC 920: 26.-27.09.2016, Freiberg

Materials Science and Engineering MSE 2016: 27.-29.09.2016, Darmstadt, further information available at: http://www.mse-congress.de.

59th International Refractory Colloquium Aachen: 28.-29.09.2016, Aachen, further information available at: http://www.feuerfest-kolloquium.de/.

FILTECH 2016: 11.-13.10.2016, Cologne, further information available at: http://www.filtech.de/.

4. CellMat 2016 mit „Special Session CRC 920": 07.-09.12.2016, Dresden, further information available at: http://cellmat.dgm.de/home.

7th Freiberger Feuerfestforum: 14.12.2016, Freiberg.

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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