EUROPEAN VIRTUAL INSTITUTE ON
KNOWLEDGE-BASED MULTIFUNCTIONAL MATERIALS AISBL

KMM-VIN Newsletter

Issue 16, Summer 2017

In this Issue:

EDITORIAL

We are presenting the 16th issue of Newsletter of the European Virtual Institute on Knowledge-based Multifunctional Materials (KMM-VIN). The Newsletter is published twice a year - in July and December.

KMM-VIN was established as the main result of the Network of Excellence KMM-NoE project of the EU 6th Framework Programme. It is an International Non-Profit Association (AISBL) established in Brussels in 2007, thus now celebrating its 10th Anniversary.

A decade has passed since the idea of KMM-VIN AISBL was brought to life. Looking back on all these years it is fair to say that KMM-VIN has developed a structure and good networking conditions for members' joint research activities. From a somewhat biased prespective of the EU New Member State like Poland, the impact of KMM-VIN on our research has been substantial. For example at the IPPT in Warsaw a number of researchers have changed their research topics as inspired by the KMM-VIN themes, a new technological laboratory has been established, quite a few PhD theses have been defended, several European and national projects have been initiated and many research papers have been published with the KMM-VIN partners. Most of these develoments would not be possible if KMM-VIN did not exist.

The KMM-VIN network is being managed by reseachers. Therefore, we are well aware that research and eduation activities of the partnership still need improvement and new ways of cooperation should be sought. For this to happen a joint effort of the KMM-VIN governing bodies and members of the association is the condition sine qua non.

KMM-VIN operates two offices: the main office in Brussels and another one at the KMM-VIN Branch Poland in Warsaw. For external clients KMM-VIN offers integrated R&D solutions, access to specialised research infrastructure and a database on the KMM materials and members' R&D expertise. Besides that KMM-VIN possess extensive experience in providing customised courses and training opportunities in the field of advanced structural and functional materials with focus on Transport, Energy and Biomedical sectors.

The purpose of the Newsletter is to highlight the main actions of the Partnership during the past six months and to present the KMM-VIN plans and events for the near future.

KMM-VIN is an open organization looking for new partners or cooperation opportunities. The Newsletter is one of the means of communicating the KMM-VIN activities to the external world.

The Summer Issue of the 2017 Newsletter commences with "Latest News" containing up-to-date information on the Partnership, its recent and forthcoming events, such as KMM-VIN Industrial Workshops and Special Sessions.

An essential part of each KMM-VIN Newsletter is "News from the Working Groups". The WGs are focused on materials R&D for the following industry sectors: WG1. Materials for Transport, WG2. Materials for Energy, WG3. Biomaterials. They are complemented by the horizontal WG4. Modelling. The WGs are organized around research themes of common interests which may lead to jointly executed work programmes or internal research projects.

In the column "KMM Projects" the readers can find concise information about selected European projects with KMM-VIN or KMM-VIN members as project partners.

The column "Cooperation" presents KMM-VIN involvement in European organisations and initiatives as well as new cooperation links with national networks on materials.

In the column "Research Fellowships, Courses and Trainings" results of the 9th Call of KMM-VIN Research Fellowships are published. Also, an updated list of KMM-VIN Specialised Courses is presented.

The current register of KMM-VIN members is given at the end of the Newsletter. For details of the KMM-VIN members, current initiatives and events please visit the KMM-VIN website www.kmm-vin.eu.

Contact details of the KMM-VIN Office can be found on the back cover.

Marek Janas, Editor

LATEST NEWS

THE 12th KMM-VIN GENERAL ASSEMBLY

The 12th Annual General Assembly of KMM-VIN was held on February 21, 2017 in Brussels. The annual activity and financial reports of 2016 and a provisional budget for 2017 were presented, voted and approved by the General Assembly. Besides the activity and financial reports the GA approved also modifications of the KMM-VIN Operating Procedures, including some modifications of the rules of the Mobility Programme for young researchers (Research Fellowships).

The GA meeting was accompanied by the annual meetings of technical Working Groups: WG2/EMEP. Materials for Energy on February 20-21, WG1. Materials for Transport, WG3. Biomaterials and WG4. Modelling – on February 22, 2017.

PARTNERSHIP

KMM-VIN is open for new members from academia and industry interested in joint research, innovation and education activities within the technical scope of four Working Groups: WG1. Materials for Transport, WG2. Materials for Energy, WG3. Biomaterials, WG4. Modelling. If a critical R&D mass within the partnership has been reached in a specific materials field not covered by the existing WGs, a new working group can be established to meet the members' interests. A recent example is the SubGroup "Graphene" which is being organized by Peter Hansen (Haydale).

Applications for KMM-VIN membership are collected on a continuous basis according to the accession procedure – cf. http://aisbl.kmm-vin.eu/node/97. The final decision on acceptance of new members is made by the General Assembly at the annual meeting held each year in February in Brussels.

At the moment KMM-VIN association is composed of 70 core and associate members from 16 European States of whom 65 are institutions (research centres, universities, industry and SMEs) and 5 are individual members. In fact the number of KMM-VIN members is higher as some core members comprise more than one university department or research institute.

RECENT KMM EVENTS

The European Materials Modelling Council (EMMC) held a workhshop on April 5-7, 2017 in Vienna. KMM-VIN was represented there by Amaya Igartua (IK4-TEKNIKER) and Jerzy Rojek (IPPT). For details, see "News from WG4. Modelling"

SEECCM 2017 – 4th South-East European Conference on Computational Mechanics was held on July 3-5, 2017 in Kragujevac, Serbia. It was co-organized by KMM-VIN member BioIRC with invited speakers from KMM-VIN partnership (IPPT, TUW, UNIPAD).

MATCH - „Building the European Materials Common House", a H2020 CSA project in which KMM-VIN was a consortium member, organised two workshops of the MATCH Sector Technical Groups on Feb. 15 and June 6-7, 2017 in Leuven, Belgium and an open Materials Forum hosted by the EuroNanoForum 2017 on June 23, 2017 in Malta.

21st DGM Symposium on Composite Materials and Material Compounds was held on 5-7 July 2017 in Bremen. KMM-VIN had been invited to organize a Special Session entitled "Recent research results in composite materials at the European Virtual Institute KMM-VIN". It comprised five lectures:

- Graphene in composite materials (Peter Hansen, HAYDALE)
- Magnesium-based composites for transport applications (Pedro Egizabal, TECNALIA)
- New trends in joining of dissimilar materials (Monica Ferraris, POLITO)
- Biodegradable and bioactive composite materials in tissue engineering (Aldo R. Boccaccini, FAU)
- Micro-CT based modeling of residual stresses and fracture in metel-ceramic composites (Michal Basista, IPPT).

Lecturers of the Special Session "Recent research results in composite materials at the European Virtual Institute KMM-VIN" held on July 6, 2017 within the 21st DGM Symposium on Composite Materials in Bremen. From left to right: Peter Hansen, Pedro Egizabal, Aldo R. Boccaccini, Monica Ferraris and Michal Basista.

This event was the first step towards establishing the cooperation between KMM-VIN and Ceramic Composites Department of Carbon Composites e.V., a German-Austrian-Swiss organisation of industry and research institutions covering the entire value chain of high-performance fiber composites. Judging from the number of attendees and the feedback obtained after the symposium the KMM-VIN Special Session has raised much interest among the participants. A follow up from CCeV is now expected.

FORTHCOMING EVENTS

The next General Assembly of KMM-VIN will be held on February 27, 2018. The GA meeting will be accompanied by the annual meetings of the Working Groups: WG2/EMEP. Materials for Energy to be held on February 26-27, whereas WG1. Materials for Transport, WG3. Biomaterials, WG4. Modelling and Sub-WG Graphene – all on February 28, 2018.

As usual the annual GA and WGs meetings will take place in Brussels but this time the venue for all the meetings will be the conference rooms at rue du Trône 98, where KMM-VIN has its registered seat.

EUROMAT 2017 – European Congress and Exhibition, the bi-annual Conference of the Federation of European Materials Societies **http://euromat2017.fems.eu/** will be held on 17-22 September 2017 in Thessaloniki Greece. This will also be an occasion to celebrate the 30th Anniversary of the FEMS. The congress will include 60 symposia divided into 7 thematic areas. See the EUROMAT 2017 booklet for more information. **http://euromat2017.fems.eu/programme/symposia-booklet/**

An important scientific and organizational contribution to EUROMAT 2017 is being provided by KMM-VIN members, who are co-organizers of at least six Congress symposia:

B5: Advanced Ceramics - Jerzy Lis, Dariusz Kata (AGH-UST);

C5: Interface Design and Modelling, Wetting and High-Temperature Capillarity - Fabrizio Valenza (CNR, KMM-VIN individual member);

C6: Joining - Christof Sommitsch (TUG);

E6: Advanced Materials for Transport Applications - Dirk Lehmhus (Fraunhofer-IFAM), Jörg Hohe (Fraunhofer-IWM);

F1: Biomaterials for Tissue Engineering - Aldo R. Boccaccini (FAU), Chiara Vitale-Brovarone (POLITO);

F4: The Next Generation of Implants with Multi-functional Properties - Aldo R. Boccaccini (FAU), Paola Palmero (POLITO).

7th KMM-VIN Industrial Workshop "Biomaterials: Key Technologies for Better Healthcare" (**IW7**) will be held on 27-28 September 2017 in Erlangen, Germany. Local organiser is Aldo R. Boccaccini (FAU) in collaboration with InnoPlant/Medical Valley Centre and FORM Laboratory-UK Erlangen.

Online registration and abstract submission: http://iw7-registration.kmm-vin.eu/ by **Sep. 15**, **2017**. For details see „News from WG3 – Biomaterials".

LightMAT 2017, a DGM Conference will be held on 8-10 November 2017 in Bremen, Germany. The focus of the conference is on light alloys (Mg, Al, Ti). Deadline for poster submissions: August 1, 2017.

More at https://lightmat2017.dgm.de/home/
Contact: Dirk Lehmhus lehmhus@uni-bremen.de

IW8 – 8th KMM-VIN Industrial Workshop on "Modelling of composite materials and composite coatings" will be held on 17-18th April 2018 in Freiburg, Germany. Chairman and local organizer - Jörg Hohe (Fraunhofer-IWM).

WHAT'S NEW IN WORKING GROUPS?

KMM-VIN is currently composed of four WGs and one Sub-WG (under construction)

- **WG1. Materials for Transport**
  Coordinators:

Pedro Egizabal, Fundación Tecnalia, Donostia/SanSebastian, Spain (TECNALIA)

Thomas Weissgärber, Fraunhofer Institute for Manufacturing and Advanced Materials, Dresden, Germany (Fraunhofer-IFAM DD)

- **WG2. Materials for Energy**
  Coordinators:

Monica Ferraris, Politecnico di Torino, Italy (POLITO)

Christof Sommitsch, Graz University of Technology, Austria (TUG)

- **WG3. Biomaterials**
  Coordinators:

Aldo R. Boccaccini, Friedrich-Alexander Universität Erlangen-Nürnberg, Germany (FAU)

Christian Hellmich, Technische Universität Wien, Austria (TUW)

- **WG4. Modelling** (crosscutting group)
  Coordinators:

Andrés Diaz-Lantada, Universidad Politécnica de Madrid, Spain (UPM)

Jerzy Rojek, Institute of Fundamental Technological Research, Polish Academy of Sciences, Warsaw, Poland (IPPT)

- **Sub-WG.Graphene** (under construction)
  Coordinator:

Peter Hansen, Haydale Graphene Industries PLC (HGI)

Internal cooperative research within the WGs are funded from participants' own sources. The only support from KMM-VIN comes through the Research Fellowship programme dedicated for young researchers to do research at other KMM-VIN member institutions.

The results of the internal projects conducted within WGs are presented at technical meetings of the Working Groups held each year in February in Brussels. Interested partners can contact the leaders of these projects and join the ongoing projects according to the accession rules adopted in each WG.

The WG members can propose new topics and seek interest from other WG partners to start new internal projects. The WG coordinators welcome such initiatives and help the project initiators establish cooperative links within the WG.

Besides new internal projects in WGs it is also possible to create new Working Groups within the technical scope of KMM-VIN in R&D fields which are not covered by the existing WGs. The necessary conditions for a new WG to be initiated are:

(i) the leadership – a commited person to start and lead the group must be known,

(ii) the critical mass of expertise – at least 7 members must express their interest in the new WG,

(iii) the technical objectives and the workplan must be outlined.

In the construction phase a label "Sub-WG" can be assigned to such initiatives.

At the KMM-VIN General Assembly meeting 2017 a new Sub-WG called "Graphene" was officially initiated. This group is looking at graphene and other 2D materials. The so far identified topics of interest are:

- Measurement of the properties of graphene
- Analytical techniques to assess the quality of the graphene
- Standardisation of graphene feedstocks
- Functionalisation methods
- Analysis of dispersion of graphene in composite materials
- Industrial applications for graphene – sensors, materials, self-diagnostic properties, energy storage, coatings
- Monitoring the EU funding programmes for graphene research topics

The Sub-WG. Graphene has been initiated and is being coordinated by Peter Hansen[1] from Haydale Graphene Industries PLC. Expressions of interest in this domain have been obtained from several KMM-VIN teams: TEKNIKER, POLITO, Fraunhofer-IWM, IOD, CSM, ITME, IMRSAS.

[1] Peter.Hansen@haydalecs.com

NEWS FROM WG1: MATERIALS FOR TRANSPORT

Summary

During the last six months the activity of WG1 has been focused on internal collaborative projects and in setting up of new collaborations for the development and characterization of innovative materials for transport applications. Three internal projects related to the production of aluminium alloys reinforced with nanodiamonds, magnesium based composites and new bainitic carbide-free ironcarbon nanostructured alloys have finished and will lead to the preparation of scientific articles that will be jointly prepared and submitted to peer-reviewed journals.

WG1 participants met in Brussels during the second day of the KMM-VIN General Assembly Meeting 2017 to discuss about the work done in the last year and future actions. The working session was also useful to present and discuss new potential collaborative projects that have eventually led up to four new collaborations.

TECNALIA will lead two new projects related to the use of ultrasound probes to disperse ceramic particulates in aluminium and magnesium alloys and to the production and characterization of nanoreinforced ductile cast iron respectively.

Furthermore a new project to be coordinated by Fraunhofer-IKTS with the participation of POLITO, University of Hertfordshire (UH) and CNR-ICMATE was presented in the field of high temperature joining with TiAl-braze for ceramics. The internal project, entitled Manufacture of joined ceramics using high temperature stable titanium aluminides started with a web conference of the partners in May 2017. Aim of the project is the adaption of the Ti-Al system as a high temperature braze for ceramic joining. The web conference finalized the working plan for this project. There are some previous results about TiAl-joining of alumina, silicon nitride and silicon carbide which indicate high temperature stability. The first cooperation started with a KMM-VIN fellowship in Torino and Genova by the PhD student Sven Roszeitis (Fraunhofer IKTS). He was working during May/June on thermal analysis and alloying processes of TiAl. Joining experiments will be performed later by different joining procedures by the project partners.

Eventually a fourth project dealing with in situ cast composites reinforced with ceramic nanocomposites was proposed by IMIM.

The GA Meeting of KMM-VIN held last February was also used to define the new fellowships for 2017. These internal fellowships are aimed at promoting the exchange of researchers between KMM-VIN institutions and to consolidate existing collaborations between research groups. Resulting from the discussions, several new fellowships have been finally awarded that are focused on materials for transport applications, e.g. "Development of Titanium-

aluminium brazes", "Stress analysis in explosion welded Al and Ti based alloys", "Simulation of welding and investigations of phase transformations in Inconel 718" and "SHS of porous MAX phases, synthesis, chemical analysis and corrosion studies".

Internal collaborative projects in WG1

Communicated by Pedro Egizabal (TECNALIA)
Co-coordinator of WG1

Magnesium based composites

This project was carried out by a group of six KMM-VIN partners (WRUT, IMBAS, IMIM, TECNALIA, IMRSAS, UNIVPM) and finished at the end of 2016.
In this project the technologies of gas pressure infiltration, squeeze casting and stir casting were used to produce different AZ91 magnesium alloy based samples. Subsequently these samples were characterized and a model to analyse the behaviour of the AZ91/ 1 wt.% TiC material was proposed.

Part of the results obtained in this project were presented by Pedro Egizabal in the lecture entitled "Magnesium-based composites for transport applications" at the 21st DGM Symposium on Composite Materials and Material Compounds held in Bremen on 5-7 July 2017. Furthermore an article prepared by Ludmila Parashkevova (IMBAS) entitled "Modelling of light Mg and Al based alloys as "in situ" composites" based on this internal project is currently in press in the series Studies in Computational Intelligence, edited by Springer.

Alumina-Aluminum FGMs

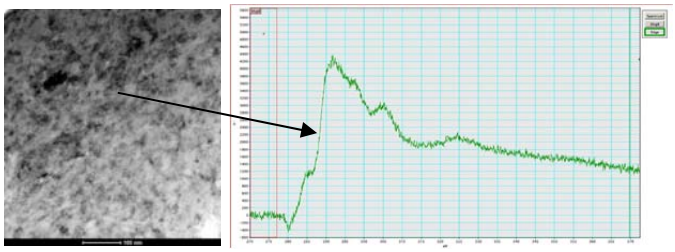
The collaborative effort in this ongoing internal project led by IPPT and ITME with WRUT, IMIM, IMRSAS, and UNIVPM as active project partners has been focused on further improving of the processing technology of FGMs made of porous alumina preforms obtained by foil casting and infiltrated with molten aluminium alloy Al12%Si using sqeeze casting (IPPT, ITME, WRUT). In parallel to the infiltration route the composites with the same chemical compositions were manufactured by the powder metallurgy (IPPT, IMIM) to assess the performance of the material obtained in either way. The squeeze cast material showed slightly better properties than its hot-pressed counterpart, although the differences were very small except for the Vickers hardness, where the infiltrated material performed much better.

The research results are now being summarised in three publications, one already in press in *Advanced Engineering Materials*, the second one submitted for publication, and the third one in preparation with the project partners.

Aluminium alloy reinforced with nanodiamonds

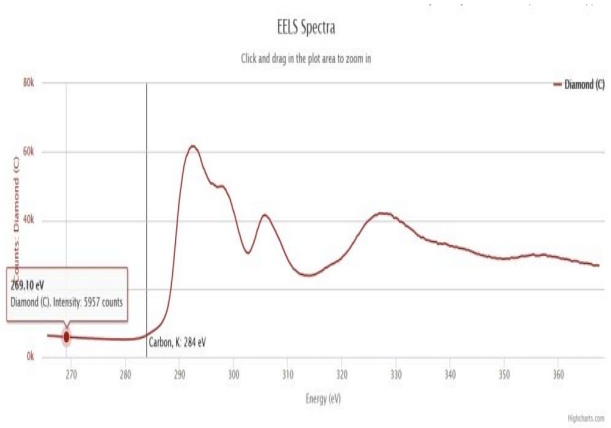
Four WG1 partners participated in this project that finished at the end of 2016. The aim was to produce aluminium based composite samples containing up to 0.5wt.% of nanodiamonds (ND) and the characterization of the produced samples.

The main challenges in the project were the production of samples with a good distribution of nanoparticulates and the search for the testing method to identify their presence in the samples.



STEM-HAADF image of Al/ND 20 wt.% composite

EELS spectrum obtained from area marked with red square



Reference spectrum for CVD Diamond

Fig. 1. Analysis of pure Al/ND samples containing up to 20 wt.% of nanodiamonds (courtesy of AGH-UST).

TECNALIA had supplied some samples of pure Al/ND 20wt.% and Al-Si7Mg0.6+0.5wt.% of nanodiamonds to UNIVPM and AGH-UST in 2016. The small amount of nanoparticules and their nature makes it extremely difficult to confirm their presence. Eventually AGH-UST devised a method to check the actual presence of the nanodiamond particulates through the combination of elemental mapping of C and Al by STEM-EDS, TEM and the use of electron energy loss spectroscopy (EELS) to check that the actual nature of the carbonaceous elements detected corresponded to diamond (Fig. 1).

The usefulness of these technologies was confirmed with samples of pure aluminium containing up to 20 wt.% of nanodiamond particulates even though it was not finally possible to confirm it in the final samples where the theoretical content was 0.5wt.% of nanoreinforcements.

Selected results of this work were shown at the national MATCOMP 2017 congress held in San Sebastian in June 2017. Additionally a journal article is being prepared to be published in 2017.

Development of new bainitic carbide-free iron-carbon nanostructured alloys.

The last step of the internal research project of WG1 ”Development of new bainitic carbide-free iron carbon nanostructured alloys” is done, by investigating the influence of cobalt addition on the fracture toughness of the developed bainite irons (Fig. 2). It was determined that the addition of 1.5 % Co leads to the maximum increase in the materials limit fracture toughness, as it can be seen in Fig. 2. The results from the Transbain project, including X-ray analysis, provided by TECNALIA, SEM analysis provided by AGH-UST and the mechanical characterizations, done by IMBAS, will be presented at the 13th National Congress on Theoretical and Applied Mechanics. The Congress will be held in Sofia at the Institute of Mechanics, Campus I of the Bulgarian Academy of Sciences, on 6-10th September 2017.

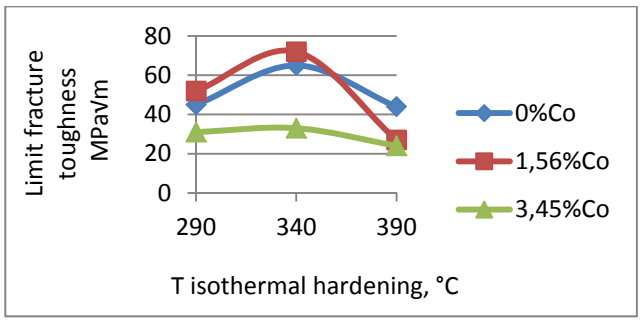


Fig. 2. Influence of cobalt addition on fracture toughness of bainite irons (courtesy of IMBAS)

News from AGH-UST

Microstructure and mechanical properties of electron beam welded Allvac 718Plus joint

Oskar Dziuba: odziuba@agh.edu.p, Adam Kruk
International Centre of Electron Microscopy for Materials Science, AGH-UST, Kraków

Welding is a major process which can be used for repairing structural elements in jet engines and gas turbines made of nickel based superalloys (including repair welding of cast materials). Electron beam welding (EBW) is a high energy beam process which uses a beam of accelerated electrons to melt edges of a material in order to create a joint between them. It can be applied without compromising on microstructural integrity of the material and mechanical properties of welded joint. The 718Plus is a relatively recently developed Ni-base superalloy combining main advantages of Waspaloy and Inconel 718. It yields keeping its mechanical properties up to 704 C (50°C higher than IN718), better weldability and lower cost of production than Waspaloy.

The present work concerns characterization of 718Plus microstructure and mechanical properties of electron beam welded 718Plus joint [1].

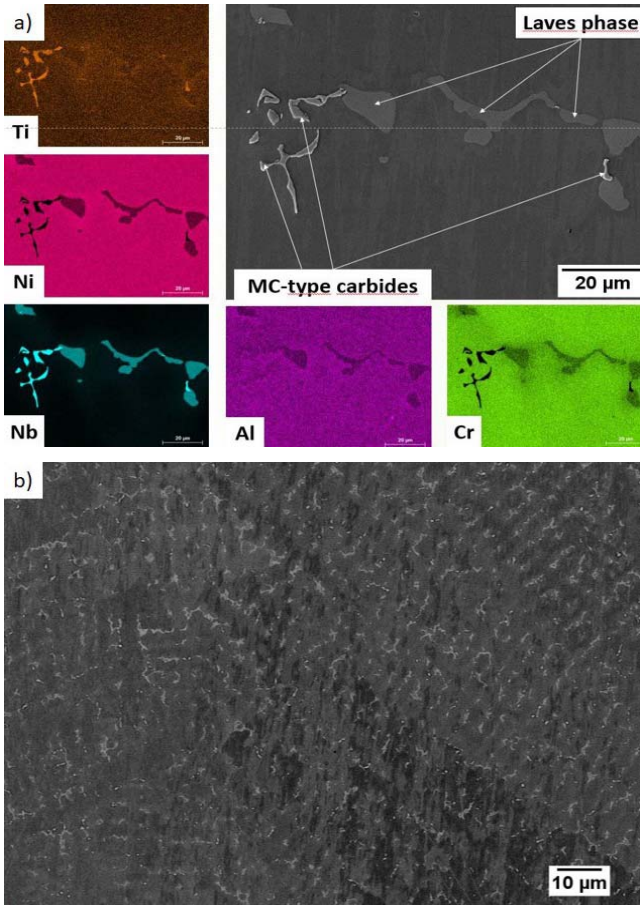


Fig. 3. a) Precipitates in the base material (SEM-SE) and SEM/EDS maps of selected chemical elements, b) Microstructure of the weld metal (SEM-SE), courtesy of AGH-UST.

The microstructure of welded sample was examined using a Zeiss Axio Imager M1m light microscope (LM) and a Zeiss Merlin Gemini II scanning electron microscope (SEM) equipped with EDS detector with Quantax 800 (Bruker) microanalysis system (Fig. 3). Microhardness was measured using a Tukon 2500 Vickers tester with a load of 2.942 N (HV 0.3). Quantitative image processing was done using ImageJ 1,50e.

The results show that in the interdendritic regions of the cast alloy both (MC-type carbides + γ) and (Laves + γ) eutectics were observed. Weld metal has the same microstructure as the base material with finer precipitates. The microsegregation observed during solidification in both base material and weld metal indicated that while Fe and Cr segregated into the γ dendrites, Nb and Ti were partitioned in the interdendritic region. Mean equivalent diameter of γ’ precipitates in the base material was measured as d_{eq} = 42.9 nm.

[1] O. Dziuba, A. Kruk, G. Michta (2016), Characterization of a microstructure and mechanical properties of electron beam welded Allvac 718Plus butt welded joint, *Inżynieria Materiałowa (Materials Engineering)*, **214**, 295-299.

From IMIM to CITEDEC

KMM-VIN Research Fellowship Report, call 2016,
by Honorata Kazimierczak (IMIM)
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Characterization of corrosion resistance of ZnMo and ZnMnMo alloy electrodeposits with and without a graphene topcoat.

The main aim of this research fellowship was to study corrosion behaviour of new functional materials such as Zn-Mo, Zn-Mn-Mo alloy coatings and multilayered systems based on Zn-based alloys with the additives of Mo, Mn and graphene. The corrosion investigation on samples prepared at IMIM were performed at CIDETEC. The study of all systems proposed (i.e. Zn, Zn-Mo, Zn-Mn-Mo and Zn-based coatings with graphene) were performed by the linear polarisation method. This initial investigation allowed to select the most interesting series of samples for a more detailed corrosion study.

The ZnMo alloys electrodeposited from aqueous citrate bath were found to be the most interesting coating material for corrosion protection of steel in chloride environments. The addition of molybdenum to the zinc layer in the range from 0.5% to 1.5 wt.% improved their corrosion resistance in chloride solutions of pH=6 as compared to pure zinc layers deposited on steel. The best effect of molybdenum addition on the corrosion resistance of Zn-Mo coatings was observed for coatings containing ~0.5 wt.% of molybdenum. In this case, the corrosion rate decreased one order of magnitude, i.e. from 20.9 μA for pure Zn to 2.6 μA for a ZnMo0.5 coating. The significant improvement of corrosion resistance of Zn-Mo coatings with low molybdenum content (from 0.5 to 1.5 wt.%) is consistent with the predictions, which took into account effects of: (i) passivation influence of molybdenum additives contained within the zinc-based coating, (ii) effect of molybdate additives on the properties of the corrosion ZnO film, (iii) lowering surface roughness by the molybdenum additives, and (iv) the influence of the texture changes.

The obtained results indicate that the crucial factor increasing corrosion resistance of ZnMo(0.5-1.5%) coating as compared to pure zinc one is the formation of a thin oxide film. The uniform oxide film on ZnMo coating seemed to be dependent mainly on the surface roughness and texture of electrodeposited Zn based layer, which can be modified by the Mo incorporation in Zn crystal lattice.

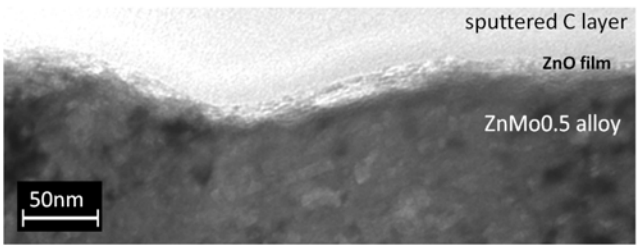

Fig. 4. Bright field TEM image showing close-up of the top layer on ZnMo0.5 coating covered with compact ZnO film (courtesy of IMIM).

News from Fraunhofer IKTS

Reported by André Clausner

1. BET-EU H2020 project „Materials Synergy Integration for a Better Europe" started in 2016 and its main objective is to promote research, innovation in nanotechnology and advanced functional materials with a focus on paper electronics. The consortium consists of Portuguese, German, British and Finish partners. The overall goal of the project is to raise the profile, competences, and visibility mainly of the involved Portuguese research entities to bring them to an internationally leading position in this increasingly complex multidisciplinary science and technology field. To reach this goal cooperation and twinning activities between the Portuguese and the other European partners, each leading research institution in their fields, will be organized and held. In the BET-EU consortium Fraunhofer IKTS covers the topic of high-resolution physical analysis of materials and devices. Within this role Fraunhofer IKTS created and conducted a Webinar on the topic nanomechanical testing in materials research, which was attended by more than 50 Portuguese students. Additionally, five Portuguese master students will perform their Master theses period at Fraunhofer IKTS in Dresden to gain practical experience in nanoanalytical techniques like SEM, TEM, nano-XCT, and nanomechanics, for which both deep methodological experience and modern tools are available at IKTS. Two of these students are currently staying in Dresden and will finish their thesis period in July 2017. For more detail check the project web pages www.bet-eu.eu and www.nanoanalysis.fraunhofer.de

2. alienS European Materials Characterization School - a new cooperation initiative with alienS (**a**toms **l**ight **i**ons **e**lectrons **S**pectroscopy) for materials characterization. The targeted audience is mainly industry, covering branches such as energy storage and conversion, health, transportation, and information technology. This initiative is organized as a French-German School with the main French partners being CEA Grenoble/ Advanced Characterization Platform, ILL, and ESRF as well as the Fraunhofer IKTS and the Dresden Fraunhofer Cluster Nanoanalysis, DFCNA on the German side. It will be co-organized by CEA-INSTN and IRT Nanoelec in France and by cool silicon e.V. in Germany. The main goal is to organize annually a one week long European School targeted primarily at the industry needs. The lectures are planned to be held on in Grenoble and Dresden simultaneously, and transferred to the other site via video conferences. Also small group hands-on case studies as well as research facility visits are planned in Dresden and Grenoble. Content-wise there will be general characterization topics covered like optical, chemical, structural, and electrical properties as well as characterization methods like electron and ion microscopy, scanning probe microscopy, X-ray

techniques and nanomechanics. More focused topics will be the surface analysis, 3D characterization, metrology, in-situ and operando characterization. The programme will be supplemented by various case studies on focused topics in the local laboratories. The first alienS European Materials Characterization School is planned to be held in late 2017.

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News from IMIM

Reported by Wojciech Maziarz; w.maziarz@imim.pl

- In the project entitled ***In-situ cast composites strengthened with ceramic nanoparticles***, funded by the National Science Centre (Poland), the first investigations concerning determination of the casting parameters for obtaining in-situ nanocomposites are conducted by AGH-UST. The next step will be characterization of microstructure and mechanical properties of nanocomposites confirming the proper casting parameters. We are open for collaboration in the field of determination of mechanical properties of samples at different temperature range.

- A new research project entitled ***Development of high-efficiency and waste-free technology for the manufacture of magnetically soft nanocomposites for high-frequency high-power processing*** has been selected for implementation by the National Centre for Research and Development, Poland. The main goal is to develop innovative technologies for production of magnetically soft nanocomposites. The project involves determination of processing parameters of several technologies like: melt spinning, mechanical alloying, vacuum hot pressing, spark plasma sintering, additive manufacturing and advanced examination of obtained magnetically soft materials. A **partner is sought** who has experience and relevant equipment for Atomic Probe Microscopy for determination of chemical composition of nanocomposites.

- New interesting results have been obtained within the project concerning the **copper based composites reinforced with carbon nanotubes**. The Cu/MWCNT composites are manufactured by the powder metallurgy including mechanical alloying and different densification methods. Currently in collaboration with the Institute of Nonferrous Metals (Gliwice, Poland) the bulk sample from milled powder composites have been produced by Spark Plasma Sintering (SPS) technique. We found a correlation between the milling time of pure Cu powders and MWCNT and damage (amorphisation) of MWCNT in densified samples. An example is presented in Fig.5 showing the TEM and HREM microstructure of SPS Cu/3vol.% MWCNT composite milled for 8 hours. This milling time preceding densification caused both formation of Cu nanoparticles embedded in partially amorphous carbon matrix as well as partial destruction of the MWCNT structure. In conclusion the 8 hour milling causes a refinement of Cu grains down to about 200 nm but also a partial amorphisation of MWCNT structure worsening their electrical properties. Therefore, shorter milling times should be applied for manufacturing of Cu/MWCNT composites.

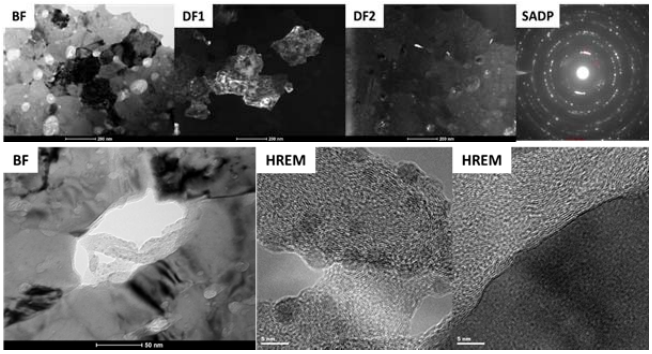


Fig. 5. TEM and HREM images of microstructure of Cu/3vol.% MWCNT composite milled for 8 hours and densified by SPS.

NEWS FROM WG2: MATERIALS FOR ENERGY

J-TECH @POLITO: Inter-departmental centre on Advanced Joining Technologies has been funded by POLITO with 2 M€ to buy the following custom-made facilities: CT-scan, multipurpose joining/testing facility, friction stir welding and laser. The J-TECH is expected to be fully operative with the new facilities within one year, but it is already functioning with the existing facilities and expertise.

Monica Ferraris, monica.ferraris@polito.it

POLITECNICO DI TORINO

ADVANCED JOINING TECHNOLOGIES J-TECH @ POLITO

J-TECH@POLITO
Advanced Joining Technology at POLITO

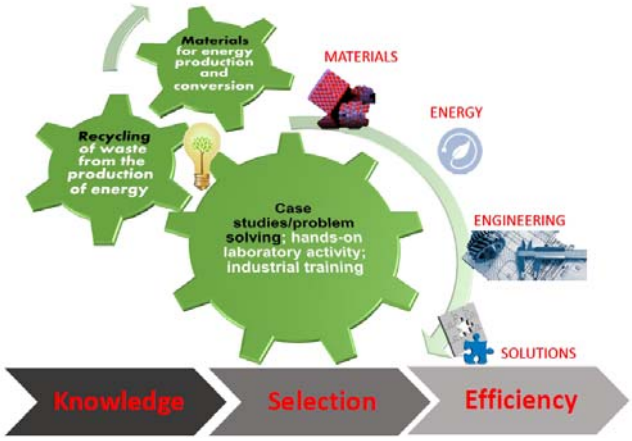
Advanced testing and monitoring of joined components with the new, custom-built J-TECH scanning facility for non-destructive testing.

Advanced joining materials and processes: J-TECH custom built, multi-purpose facilities to join and test every kind of material.

Advanced modelling of joints: validation of structural modelling and design capability for emerging processes.

POLITO: Advanced Materials for Energy

A new course (60 hours, 6 credits) at POLITO starting from March 2018. Details in the column "Fellowships, Courses, Trainings"



Monica Ferraris and KMM-VIN WG2 colleagues

News from IK4-CIDETEC

IK4-CIDETEC is part of the **INTEGRAL** project´s consortium, constituted by a unique combination of Research and Technology Organizations and Industries, including material producers, technology developers and end-users. INTEGRAL is an Innovation Action project coordinated by CEA within the PILOTS-01-2016 call of the Horizon 2020 Framework Programme. INTEGRAL is indeed expected to be a decisive milestone in industrial production and sustainable use of thermoelectric generators for energy harvesting. In particular, IK4-CIDETEC is providing its cutting-edge knowledge in advanced wet-chemistry approaches to modify the grain surfaces of thermoelectric powders in order to integrate well-controlled grain boundary engineering in bulk thermoelectric materials and to improve consequently the final performance of the thermoelectric devices in the final application. Further information about the project may be found at http://liten.cea.fr/cea-tech/liten/Pages/actualites/Kick-off-Meeting-INTEGRAL-Project.aspx

See also news from Fraunhofer IKTS below.

From TUC to AGH-UST

(KMM-VIN Research Fellowship, call 2016)

Long-term creep behaviour of 9Cr3W3CoVNbBN heat resistant steels in terms of microstructural evolution. Within the KMM-VIN Fellowship of 2016 the PhD student **Kevin Gordon Abstoss** got the opportunity to enhance the research collaboration between Chemnitz University of Technology and AGH University of Science and Technology.

The research stay at AGH was assessed as very productive in terms of microstructural characterisation of heat resistant steels. Several modern characterisation methods were used reaching from light optical microscopy to high resolution electron microscopy to characterise the microstructure of boron alloyed 9 wt.-% chromium steels. The work was mainly focused on examination of different conditions such as heat treated ingots and pipes as well as long term creep exposed samples. As a result of many intense investigations a complex network of segregation zones could be characterised by SEM, STEM and quality EDS mappings (Fig.6). The output-driven work was very positive and is the basis for further collaborative work with AGH-UST

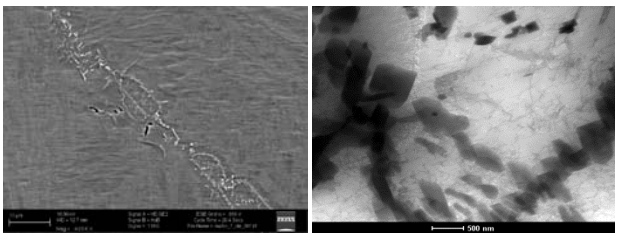


Fig. 6. SEM and STEM image of complex micro-segregation network of a MARBN ingot (courtesy of TUC)

kevin.abstoss@mb.tu-chemnitz.de

From AGH-UST to INTA

(KMM-VIN Research Fellowship, call 2016)

The effect of oxidation on the microstructure of Allvac 718Plus superalloy for aeronautics and power generation

The research activities at INTA, funded by the KMM-VIN Research Fellowship 2016 were supervised by Alina Agüero. The investigations were focused on the effect of high temperature oxidation on the microstructure of new polycrystalline nickel-base superalloy Allvac 718Plus.

For the experiment two different atmospheres of oxidation were chosen – dry synthetic air and air containing 10% of water vapour ("wet air"). The samples were oxidized at 850 °C for 120, 1000 and 2000 hours. Samples oxidized for approx. 3500 hours are actually still tested in furnaces at INTA. The mass gain (Fig. 7) of the specimens was different for the two different experimental conditions. Samples oxidized in dry air after the first 72 hours gained more mass per cm^2 than those oxidized in 10% water vapour. As the experiment continued, the oxidation rate slowed down for samples oxidized in dry air, so after about 500 hours all samples oxidized in 10% water vapour gained more mass.

Further investigations mainly electron microscopy (SEM, TEM) with support of other techniques are being continued at AGH-UST. First step was to identify the phase composition of the oxide scales formed on the 718Plus superalloy (Fig. 8). It was found that the scales contain mainly Cr_2O_3 with some other oxides enriched mainly in Ti and Fe.

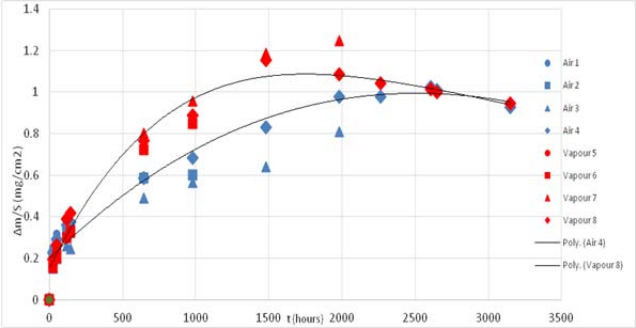


Fig. 7. Diagram showing the mass gain per surface with oxidation test duration at 850 °C (courtesy of AGH-UST).

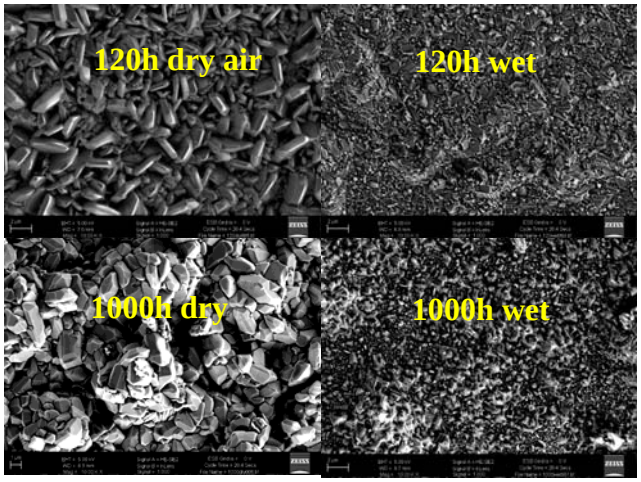


Fig. 8. SEM images showing morphology of oxide scales after 120 and 1000 hours of oxidation in dry synthetic air and 10% water vapour ("wet") air at 850 °C (courtesy of AGH-UST).

Up to now, SEM and SEM-EDS investigations of the scale and bulk materials were conducted, while TEM analyses are in progress. Results of joint investigations will be presented at the XVI International Conference on Electron Microscopy [1]

[1] S. Lech, G. Cempura, A. Aguero, A. Kruk, A. Czyrska-Filemonowicz, Microstructure of the oxide scale formed on Allvac 718Plus superalloy during oxidation in dry- and wet air characterised by analytical electron microscopy, (abstract submitted to XVI Int. Conf Electron Microscopy, 10-14.09.2017, Jachranka, Poland to be published in *Int. Journal of Materials Research*.

Sebastian Lech: slech@agh.edu.pl, Int. Centre of Electron Microscopy for Materials Science, AGH-UST, Kraków

News from Fraunhofer IKTS

Reported by Hans-Peter Martin, IKTS

1. INTEGRAL - an Innovation Action project coordinated by CEA within the PILOTS-01-2016 call of the Horizon 2020 Framework Programme. INTEGRAL involves industrial producers and converters of thermoelectric materials as well as their end-users and final customers, thus covering the whole development chain.

Three major Pilot Lines or Technology Platforms in Europe will support key industrial stakeholders in improving material performance and process parameters, which will allow them to scale-up industrial production of thermoelectric materials.

Thermoelectric materials are able to directly convert heat into electricity. The conversion yield is low, but when the heat is lost anyway, like in thermal engines or in energy intensive industries, any benefit is good to take.

Fraunhofer IKTS is one of the 12 partners of this consortium. Its project contribution consists of experimental development and optimisation of joining processes and the thermoelectric characterisation of materials and modules. The modification and adaption of specific parameters and materials is supposed to improve the reliability and efficiency of thermoelectric generators.

2. A test stand for heating elements under extreme temperature conditions is about to be installed at Fraunhofer IKTS. The conditions of testing can reach 2200 C under high vacuum atmosphere (10^{-5} mbar). The tests are performed to study the operational behaviour of heating elements which are heated up by electrical power themselves to produce the extreme temperature. Variable current up to 2000 A and low voltage is supplied by the device so that refractory metals and electrical conductive ceramics like ZrC can be analysed.

3. The resistance against water vapor corrosion in flowing atmospheres at high temperatures is a very important property for materials which are used for energy applications. The current material focus of IKTS is ceramic matrix composites (CMCs) for gas turbine applications. The degree of surface recession and microstructural changes under such conditions has a rising impact on the material development.

Fraunhofer IKTS is testing a growing number of CMCs and environmental barrier coatings (EBCs) of leading companies of aviation industry in its high temperature burner rig (HTBR), a unique test facility in Europe. Testing is carried out with burned natural gas atmosphere. The overall pressure is 1 atm and the water vapor partial pressure is adjustable between 0.2 atm and 0.28 atm. Testing temperature and gas velocity can be controlled from 900 C to 1450°C and 50 m/s to 100 m/s, respectively. Tests can be performed for all material types.

The test stand generates valuable experimental data about corrosion behavior which can be additionally used for the development of corrosion models, simulation procedures and validation of theoretical estimations.

NEWS FROM WG3: BIOMATERIALS

IW7 – 7th KMM-VIN Industrial Workshop on Biomaterials: Key Technologies for Better Healthcare will be held on 27-28th September 2017 in Erlangen, Germany.

The workshop is organized by the Institute of Biomaterials, University of Erlangen-Nuremberg (FAU), InnoPlant/Medical Valley Centre, FORM Laboratory-UK Erlangen and European Virtual Institute on Knowledge-Based Multifunctional Materials (KMM-VIN AISBL).

Chair: Aldo R. Boccaccini (FAU Erlangen)

Co-Chairs:
Heike Walles (University of Würzburg)
Stefan M. Sesselmann (FAU Erlangen)

IW7 - Online Registration:
http://iw7-registration.kmm-vin.eu/

Abstracts (max 300 words) due by September 15, 2017

The programme can be downloaded from:
https://www.kmm-vin.info/

Keynote lectures

Functionalization of surfaces and applications in healthcare surroundings, Frank Heidenau (BioCer Entwicklungs-GmbH)

Opportunities and challenges of 3D printing in healthcare applications, Tim Van Cleynenbreugel (3D Systems)

Requirement for ceramic implants for hip joint prostheses, Thomas Oberbach (Mathys MedicalAG)

Soluble phosphate glasses and composites as key biomaterials, David M. Healy (IDP Services Ltd)

Cell meets textiles – towards biohybride implants, Stefan Jockenhövel, RWTH Aachen University

LIPUS – Low Intensity Pulsed Ultrasound for bone healing purposes: Only a gimmick or mechanism-based bone regenerative approach? Jochen Salber, Universitätsklinikum Knappschaftskrankenhaus Bochum

Cartillage tissue engineering with biomaterials developed for cartilage repair, Gundula Schulze-Tanzil, Institute for Anatomy, Klinikum Nürnberg Medical School

Recent multiscale mechanics contributions to bone tissue engineering, Christian Hellmich, TU Vienna, Austria

Surgery and tissue engineering. What is the role of vascularisation? Raymund Horch, University Hospital Erlangen

Mimicking Bone Technology: Transforming implant surfaces from an artificial barrier into a smart implant body interface, Dietmar Schaffarczyk (stimOS GmbH)

FAU - AGH-UST collaboration on bioactive, antibacterial coatings

Following the research stay of Joanna Karbowniczek (group of Aleksandra Czyrska-Filemonowicz, Faculty of Metals Engineering and Industrial Computer Science, AGH University of Science and Technology) at the Institute of Biomaterials (Head: Aldo R. Boccaccini, FAU), research in the field of bioactive, antibacterial coatings has expanded, this being one of the topics selected for joint collaboration within WG3. In particular, recent joint research published in *Mater. Sci. Eng.* C [1] has shown the fabrication and characterization of a new family of organic/inorganic coatings containing zinc oxide nanoparticles (nZnO). The coatings were obtained on 316 stainless steel substrates by electrophoretic deposition (EPD) combining alginate, chitosan (both biocompatible natural polymers) and nZnO in a layered structure. Antibacterial tests against both gram-positive and gram-negative bacteria were carried out to confirm that the presence of nZnO is effective to prevent bacterial growth.

In addition, it was shown that the corrosion resistance of the substrate in cell culture medium increased when the samples were coated with layers containing nZnO. The novel coatings are considered suitable alternatives for the surface modification of metallic implants. The research was carried out in collaboration with partners at Indian Institute of Technology-Gandhinagar, India, School of Geography, Earth and Environmental Sciences, University of Birmingham, UK, and Jena University Hospital, Germany.

[1] J. Karbowniczek et al., Electrophoretic deposition of organic/inorganic composite coatings containing ZnO nanoparticles exhibiting antibacterial properties (2017), *Mater. Sci. Eng. C*, **77**, 780–789. (https://doi.org/10.1016/j.msec.2017.03.180)

TUW–WUT: Fracture safety of double-porous hydroxyapatite biomaterials

As an outgrowth of KMM-VIN collaboration between Institute for Mechanics of Materials and Structures of TU Wien (TUW) and Department of Materials Science and Engineering, Warsaw University of Technology (WUT), supported through the COST-Action NAMABIO, interesting results on fracture of double-porous biomaterials were presented in the paper [1] awarded by the journal as the paper of the year 2016 (see “Personalia”).

Biological requirements call for substantial porosities in clinical biomaterials – challenging the mechanical integrity and strength of the latter. In this study, the authors resort to quantitative engineering principles to assess the fracture safety of double-porous hydroxyapatite ceramics: microcomputed tomography scans give access to the morphology of macropores at the submillimeter scale, as well as to voxel-specific microporosities (Fig. 9).

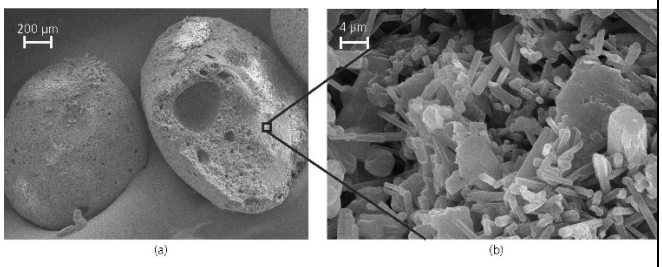


Fig 9. a) SEM pictures of hydroxyapatite granules; b) zoom-in to resolve the single crystals with microporosity in between

Advanced micromechanics of porous ceramics with needle-shaped elementary units then allows for translating voxel-specific microporosities to corresponding elasticity and strength properties, as well as to macro-to-micro scale transition (‘concentration’) tensors. These mechanical properties and tensors are fed into a large-scale finite element model of a biomaterial granule as used for mandibular tissue regeneration. Loading the granule in splitting mode, up to physiological strain, evidences stress concentrations at the loaded poles and close to internal macropores and cracks. A parallel computing-supported subvoxel analysis of needle orientations evidences that in highly loaded regions, the intravoxel ‘single crystals’ oriented perpendicularly to the loading direction undergo the most unfavorable loading. Still, only 0·6% of the finite-elements show stresses indicating failure, and the mean safety factor against fracture is as high as 7.

This analysis confirms, from an engineering science viewpoint, the successful use of the investigated biomaterials in clinical practice.

[1] A. Dejaco, V.S. Komlev, J. Jaroszewicz, W. Swieszkowski and C. Hellmich (2016), Fracture safety of double-porous hydroxyapatite biomaterials, *ICE Journal Bioinspired, Biomimetic and Nanobiomaterials*, **5**, 24-36 http://www.icevirtuallibrary.com/doi/abs/10.1680/jbibn.15.00021 (see also “Personalia”).

CIDETEC: Highly hydrophilic coatings

CIDETEC patents highly hydrophilic coatings that reduce by up to 80% the wear of prosthesis.

The osteolysis generated by the small fragments released due to wear is the main cause of failure in long-term joint prostheses.

Between 30-60% of implanted prosthesis and manufactured in ultra-high molecular weight polyethylene fail at 10 years because the small particles released by wear and tear generate osteolysis. The main manufacturers of prostheses have replaced this material with materials that have greater resistance to wear. However, some of them have shown a low resistance to fatigue after long implantation times. Today, polyethylene remains the gold standard for prostheses manufacturers, who continue to seek to optimize wear resistance and oxidation without losing resistance to fatigue.

By mimicking the surface of natural joints, CIDETEC has developed a technology that keeps the surface of the friction torque of the prosthesis permanently lubricated and hydrated. The coating is highly biocompatible and does not alter the synovial fluid or the natural lubricants, thus avoiding the non-specific adsorption of proteins.

This type of coating has been tested on a test bench during five million cycles and the wear rate of polyethylene has been reduced by up to 80% in comparison to uncoated material. This technology has been recently patented and its commercial exploitation is currently being worked on.

Fraunhofer IKTS: Investigations of silicon nitride materials for medical applications

The goal of the project is to modify silicon nitride ceramics to study the effect of biological interaction with the ceramic. This will become a base for future work how to adapt silicon nitride for medical use.

Silicon nitride manifests the best mechanical performance of all engineering ceramics. Together with zirconia it is outstanding with regard to fracture toughness what makes it attractive as a substitute for bones and joints.

NEWS FROM WG4: MODELLING

IW8 – The dates and venue of the **8th KMM-VIN Industrial Workshop** on materials modeling have been fixed: 17-18th April 2018 at Fraunhofer IWM in Freiburg, Germany. The title of the workshop is "**Modelling of composite materials and composite coatings**" The local organizer and the chairman is Jörg Hohe (Fraunhofer-IWM).

EMMC International Workshop, Vienna 2017

The European Materials Modelling Council (EMMC) held its first International Workshop 2017 in Vienna on 5-7th April. The workshop was organized by Nadja Adamovic (EMMC Coordinator) and Ernst D. Janotka from TU Wien, supported by the H2020 project (EMMC-CSA).

The KMM-VIN Working Group on Modelling (WG4) was represented at this workshop by Amaya Igartua (IK4-TEKNIKER) and Jerzy Rojek (IPPT, WG4 Co-Coordinator).

The general objective of the workshop was to boost the networking of different type stakeholders in material modelling, to provide a communication platform across different stakeholder communities, and to provide their input on the future materials modelling. The workshop gathered about a hundred international experts from Europe and USA on material modelling, who were invited to discuss and contribute to setting common directions in areas of material model development and its implementation in computer software, and finally its transfer to an industrial use. The stakeholders included model developers, translators, software owners and end users.

The workshop comprised a number of plenary lectures and 15 working sessions. The session topics included:

1. Impact of barriers and breakthroughs: bridging the communication and expectations gaps between model developers and industrial stakeholders
2. Improved community integration, communication and interoperability
3. Translation (of innovation from the academy to industry) in practice. What we can learn from big companies, software owners?
4. Getting SMEs more involved in materials modelling
5. Towards better material models
6. Repositories of materials (modelling) data and knowledge
7. Success stories and how to widen success throughout European industry
8. Marketplace services – requirements from stakeholders
9. Training and exploitation
10. Industrial deployment of materials modelling software: current practice, constraints and barriers
11. Integration of materials modelling into Business Decision Support Systems modelling
12. Economic impact of materials modelling.

The workshop ended with a Podium Discussion, summarizing conclusions from the working sessions. The participants recognized an importance of materials modelling for industrial innovation. The outcome of this event will be integrated within the EMMC Roadmap 2017

From WUT to IMRSAS

(KMM-VIN Research Fellowship, call 2016)

Mateusz Szymanski, WUT

Thermodynamic assessment of Fe-B system

The research stay at IMRSAS (Košice, Slovakia). was funded by KMM-VIN and was carried out under the supervision of Viera Homolová. The studies were focused on thermodynamic assessment of the Fe-B binary system which is important for steels and magnetic materials. Calculations were performed in the ThermoCalc software ver. 4.1 equipped with two different databases: the commercial SSOL5 database for solid solutions (substitutional approach) and the USER database based on work of T. Van Rompaey et al. (intersticial approach).

Results obtained were compared with experimental data gathered from work of M. Van Ende et al. In low boron regime the curve of the Fe-B phase diagram is represented more reliably in the USER database. However, temperatures of the phase transformations are calculated with more accuracy in the SSOL5 database. For boron content higher than 0.3 mole fraction phase transformation temperatures are better assessed in the USER database, except for melting point of the Fe_2B phase.

Gibbs energy, enthalpy and heat capacity of FeB and Fe_2B are difficult to evaluate because experimental data are dispersed and inaccurate. Activities of iron and boron in liquid Fe-B alloy, calculated at selected temperatures, are almost identical for both databases. The Fe-B phase diagram simulated in SSOL5 database is presented in Fig. 10. For more details see [1].

[1] M. Szymański, V. Homolova, M. Leonowicz (2017), Thermodynamic Assessment of the Fe-B System in the SSOL5 and User Databases, *International Journal of Engineering Research and Applications*, **7**, 59-62. DOI:10.9790/9622-0701015962

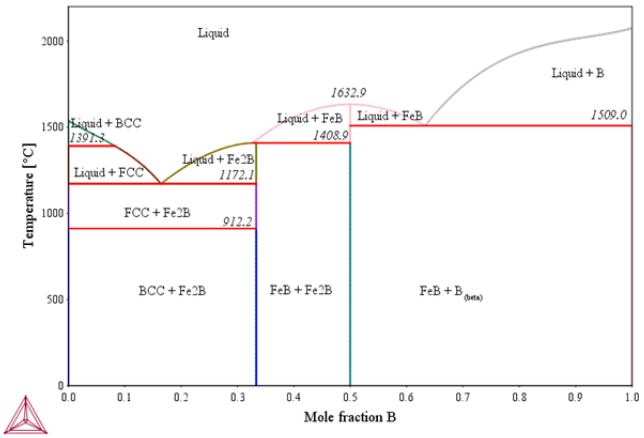


Fig. 10. Fe-B phase diagram simulated in SSOL5 database

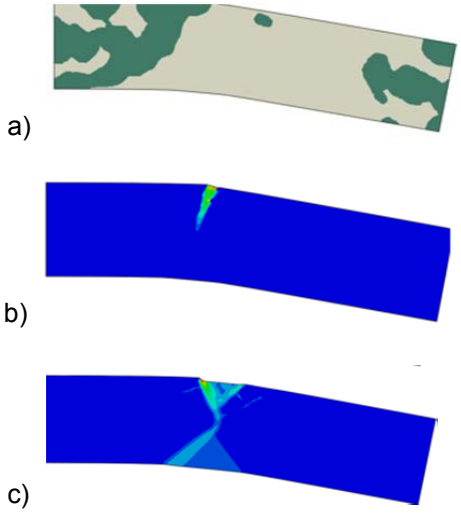


Fig. 11. Failure mode / Equivalent plastic strain distribution of cantilever beam in micromechanical bending: a) schematic microstructure, b) plane stress, c) plane strain.

From POLIMI to IPPT

Fracture Modelling of MMCs

A bilateral research project (an internal WG4 project) has been initiated by POLIMI and IPPT. The joint activities comprise a comphensive investigation of deformation and fracture of Cr/Al_2O_3 composite with particular focus on the effect of material microstructure (interfaces) on mechanical response.

Material samples produced at IPPT were subjected to different laboratory tests. The macroscopic material characteristics were evidenced by Rockwell indentation performed at 200 N maximum load at POLIMI. A microscopic verification study on the local material properties was done by Berkovich indentation at 20mN and 200 mN maximum load on homogeneous metal and ceramic samples. The analysis was performed by Dario Gastaldi and Pasquale Vena at Labs (Laboratory of Biological Structure Mechanics) in POLIMI. The results have been compared with those obtained at the National Centre for Nuclear Research in Poland, where an attempt. has been made to test the single phases embedded in the composite.

In parallel, numerical models of deformation and fracture of Cr/Al_2O_3 composite on the microscale have been developed. The experimental base for this modelling work had been provided by the micromechanical compression and bending tests performed at MCL (Leoben, Austria) in cooperation with Montanuniversität Leoben by Witold Węglewski (IPPT) and Kamil Bochenek (IPPT), the latter within the KMM-VIN Research Fellowship 2013.

Numerical simulations of micro-cantilever bending were further developed by Pitchai Pandi (POLIMI) during his stay at IPPT supported in part by the KMM-VIN Research Fellowship 2016. The influence of computational hypotheses on the structural response is shown in Fig. 11. A joint journal paper is now being prepared. Pitchai Pandi has recently defended his PhD thesis entitled ‘Computational micromechanical analysis of metal-ceramic composites’. The work has been carried out under the joint supervision of Gabriella Bolzon (POLIMI) and Michal Basista (IPPT). Dietmar Gross (TUD) and Daniela Boso (UNIPAD) were sitting in the PhD Evaluation Committee at POLIMI.

Gabriella Bolzon, POLIMI

KMM PROJECTS

KMM-VIN was a partner in the Horizon 2020 CSA project **MATCH** - “The Alliance for Materials way to the creation of the MATerials Common House” which was completed on 30th June 2017 (cf. http://www.match-a4m.eu). Besides KMM-VIN, TECNALIA and IK4-TEKNIKER (members of KMM-VIN) participated in this project playing the role of WP leaders.

The MATCH project has worked out a number of useful tools and databases showing the diversity of Materials research in Europe. These deliverables will be used after the project’s end by various European organisations.

However, the main issue of MATCH was to define a sound raison d'être for Sector Technical Groups (STGs) for the time after the project end, as the STGs under the umbrella of Alliance for Materials will remain the main building blocks of the European Materials Common House. KMM-VIN was involved in this challenge trying to help FEMS and other MATCH partners identify a binding theme for the STG activity in the post-project time and devise ways to ensure STGs sustainability once the project fudning has been finished. These problems were intensively discussed at two STG Workshops held on 15th Feb. 2017 and 6-7th June 2017 in Leuven, Belgium.

One of the recurring theme the experts of STGs could focus on in the future were the “materials commonalities across the industry sectors” that coud be expressed as potential horizontal topic calls in the last Work Programmes of H2020 and be included in the conceptual process of FP9 preparation. Several MATCH partners and experts of STGs have agreed to continue with the STG activity on a voluntary basis. The 3rd STG Workshop is envisaged in November 2017 at EPFL Lausanne.

In several EU projects two or more KMM-VIN members were involved as partners. Such projects are indicators of integration between KMM-VIN members. Some of the running projects of that type are shortly presented below.

INTEGRAL – Initiative to bring the 2nd generation of thermoelectric generators into industrial reality. Innovation Action project within PILOTS-01-2016 with 7M€ EU funding for 3 years. The project consortium coordinated by CEA consists of 12 partners, including KMM-VIN partners: Fraunhofer IKTS and CIDETEC. The project kick-off meeting was held at CEA LITEN, Grenoble, on February 20, 2017. For more information on INTEGRAL - see “News from WG2”.

BIONECA COST Action: "Biomaterials and advanced physical techniques for regenerative cardiology and neurology" started in October 2016 for 4 year period. It is coordinated by Franco Rustichelli (UNIVPM) and other members of the KMM-VIN Partnership: Aleksandra Czyrska-Filemonowicz (AGH-UST) and Christian Hellmich (TUW) are in the project Management Committee.

PneumoNP – „Development of a theragnostic system for the treatment of Gram-negative bacterial infections of the lung” is an FP7 collaborative (2014-2018) project coordinated by CIDETEC.

MOZART – “Mesoporous matrices for localized pH-triggered release of therapeutic ions and drugs", a H2020 project focusing on introduction of nanomaterials to medical applications. In the 11-member academia – SMEs partnership three KMM-VIN members are present: POLITO (coordinator), FAU and UCM.

NICRRE – “**Innovative Ni-Cr-Re coatings with enhanced corrosion and erosion resistance for high temperature applications in power generation industry**”, a new cooperative project submitted to the MERA-Net call by four KMM-VIN members: ITME (coordinator), IPPT, WUT, IMRSAS and one large industrial company SEFAKO S.A. from the energy sector in Poland. The proposal has been approved and funded with 785.000 € grant. The project will start on 1st October 2017 for the duration of three years.

NICRRE can be regarded as the KMM-VIN inspired research initiative belonging to WG2. Materials for Energy.

COOPERATION

European Technology Platform on Advanced Engineering Materials and Technologies (EuMaT)

KMM-VIN maintains strong interactive links to EuMaT European Technology Platform with Arnaldo Moreno (ITC), Rod Vanstone (ALSTOM), Pedro Egizabal (TECNALIA) and Michal Basista (IPPT) serving as members of EuMaT Steering Committee.

The updated Strategic Research Agenda (SRA) of EuMaT, with the substantial KMM-VIN members’ input to the section on Structural and Functional Materials, was published in June 2017. It can be downloaded from EuMaT website (www.eumat.eu).

Alliance for Materials (**A4M**)

It comprises six European Technology Platforms (EuMaT, SusChem, Manufuture, FTC (TEXTILE), ESTEP and SMR), two large European materials societies (E-MRS and FEMS) and Energy Materials Industrial Research Initiative (EMIRI) with the goal to develop, verify and implement effective coordination schemes of materials research across different sectors, in the frame of the EU research and innovation programmes. Michal Basista is a member of A4M Management Board. The most recent actions of A4M were those within the MATCH CSA project. Here, the effort of the A4M members led by FEMS, EuMaT ETP and TEXTILE ETP was focused on keeping operative the A4M Sector Technical Groups after the project end date (see the note on MATCH in “KMM Projects”).

Ceramic Composites Department of Carbon Composites e.V.

www.carbon-composites.eu/en/network

Last September the Ceramic Composites Department of CCEv initiated a contact with KMM-VIN to exchange experience on how to run a non-profit research association and discussed possible ways of future cooperation. Following that first encounter a Special Session on **“Recent research results in composite materials at the KMM-VIN”** was organized at the DGM 21st Symposium on Composite Materials and Material Compounds (Bremen, 5-7 July 2017, see “Recent KMM-VIN events”) to present the technical profile and interests of KMM-VIN partnership.

It was agreed in Bremen that Ceramic Composites Department of CCEv will discuss the next steps internally and get in touch with the KMM-VIN CEO.

KMM-VIN RESEARCH FELLOWSHIPS, COURSES and TRAININGS

Call for KMM-VIN Research Fellowships 2017

The KMM Mobility Programme awards Research Fellowships on a competitive basis for PhD students and early stage researchers from the KMM-VIN network to do research at other KMM-VIN member institutions.

The 9th call of KMM-VIN Research Fellowships was closed on March 31, 2017. The submitted 13 eligible applications with in total 16 requested person months were reviewed by the Research Fellowship Committee, consisting of the Chair of the KMM-VIN Mobility Programme and Coordinators of KMM-VIN Working Groups. At the KMM-VIN General Assembly 2017 in Brussels it was decided to maintain the 2016 increased budget for the Mobility Programme and to fund 9 person months from the regular KMM-VIN budget in this call. In addition, two person months were awarded as Profs Appendino grant (financed by POLITO). Finally, the following applicants were granted with in total 11 person months in the 9th call:

Applicant	Host	Duration *months*	Start date
S. Roszeitis Fraunhofer IKTS *Appendino Grant*	M. Ferraris (POLITO)	1.0	2017-05-01
K. Golasinski (IPPT)	A. Boccaccini (FAU)	1.0	2017-09-01
PK.Gianchandani (POLITO)	I. Dlouhy (IPM)	1.0	2017-08-01
S. De la Pierre (POLITO) *Appendino Grant*	P. Tatarko (IMRSAS)	1.0	2017-06-15
K. Frydrych (IPPT)	A. Prakash (FAU)	1.5	2017-08-01
T. Sustersic (BioIRC)	A. Boccaccini (FAU)	0.5	2017-Sept.
K. Majewska-Zawadzka (AGH)	M. Salvo (POLITO)	1.0	2017-09-04
D. Fronczek (IMIM)	K. Saksl (IMRSAS)	1.0	2017-08-01
O. Dziuba (AGH-UST)	P. Mayr (TUC)	1.0	2017-10-01
A. Koniuszewska (WRUT)	P. Egizabal (TECNALIA)	1,0	2017-11-01
P. Pokorny (IPM)	M. Grasso (UH)	1.0	2017-10-01

More information on KMM-VIN Research Fellowships is available in the Members' Area of KMM-VIN website.

Joint publications of the fellowship holder and the host are expected as a result of the KMM-VIN Research Fellowship within 12 months after the research stay completion. The up-to-date published papers resulting from KMM-VIN RF stays are listed on www.kmm-vin.eu and can be accessed using the link: http://aisbl.kmm-vin.eu/node/444

KMM Specialized Courses offered by Members

KMM-VIN has prepared the 2017/2018 offer of Specialized Courses dedicated to both industry and science communities. They are tailored to the needs of customers from the fields of materials design, processing technologies, fundamentals of chemical and physical processes, thermodynamics of complex materials, characterization of materials microstructure and properties, modelling of material properties and response to in-service conditions. The courses entail lectures, practices and case studies. They can be delivered at company's premises, at KMM-VIN members' location, or as e-learning.

These courses are designed for experienced staff members, who want to improve their skills in a selected field, but also for non-experienced employees, who would like to gain basic knowledge in the field. The courses are offered on a continuous basis upon individual arrangement with the interested parties. The fees depend on the type and extent of the course and will be agreed upon with the customers on case by case basis. More information on these courses may be found on KMM-VIN webpage (a detailed booklet to be downloaded) using the following link:

http://aisbl.kmm-vin.eu/node/95

Interested companies can contact the coordinators of KMM-VIN training services:

Arnaldo Moreno Berto, amoreno@itc.uji.es

Gabriella Bolzon, gabriella.bolzon@polimi.it

KMM-VIN Specialised Courses for 2017/2018

MATERIALS

- Adhesive bonding (LU)
- Biomaterials (FAU)
- Development and applications of micro-structured and micro-textured materials (UPM)
- Light alloys and composites (IOD)
- Materials for energy systems and advanced steam power plants (AGH-UST)
- Materials for aeronautics and aerospace (AGH-UST)
- Materials science and technology (POLITO)
- Nanomaterials for biomedical applications (FAU)
- Nickel based superalloys (AGH-UST)
- Sustainable use of materials (LU)

PRODUCTION PROCESSES

- Automotive body materials (UH)
- Colloidal processing (FAU)
- Electrophoretic deposition (FAU)
- Foundry (TECNALIA)
- Heat treatment of welded joints (ISPL)
- International / European Welding Engineer / Technologist / Specialist (ISPL)
- International welder (ISPL)
- Plastics processing technology (LU)
- Rubber compounding and processing (LU)

CHARACTERIZATION TECHNIQUES

- Joining of dissimilar materials and mechanical tests of joints (POLITO)
- Electron microscopy (AGH-UST)
- Experimental techniques for biomaterials and biological tissues (POLIMI)
- High-temperature materials characterization in liquid and semi-liquid states (IOD)
- Material characterization via depth sensing indentation tests (IMBAS)
- Microstructural analysis and characterization by microscopy and tomography (AGH-UST and TECNALIA)
- Stress analysis of texturized materials by X-ray diffraction technique (IMIM)
- Testing methods for materials at high temperature and in aggressive environments (IOD)

MODELLING TOOLS

- Advanced multiphase and multi-scale material modelling (IMBAS)
- Constitutive and damage models (POLIMI)
- Damage and fracture mechanics (POLIMI)
- Design and modelling of micro-structured and micro-textured materials (UPM)
- Finite element modelling (POLIMI)
- Fracture mechanics of piezoelectric composites (IMBAS)
- Identification procedures (POLIMI)
- Modelling and numerical simulations of multiphase composites (IMBAS)
- Models for biomaterials and biological tissues (POLIMI)
- Sintering of metal-ceramic composites: modelling of the process, measurement and prediction of residual stresses and mechanical properties (IPPT)
- Tissue engineering: biomaterials and cardiovascular systems (BIOIRC)

RISK MANAGEMENT

- Risks in Industry (R-TECH)
- Asset/plant Oriented Risk Management (R-TECH)
- Health, Safety, Security and Environment (R-TECH)
- Risk Governance (R-TECH)
- Risk Based Inspection R-TECH)

Master-level Course at POLITO

Advanced Materials for Energy, a new course (60 hours, 6 credits) offered at POLITO, in English, starting from March 2018 (if the number of enrolled students is higher than 15).

Subject Fundamentals: The students will be involved in case studies to be presented to companies of the energy sector, hands-on laboratory activities and training aimed at improving their problem-solving skills, also in synergistic activities with other master level courses. Additionally, the course will organize visits to selected energy companies and research centres (also to facilitate ideas for collaborative projects and internships) in Italy and abroad, with particular interest for activities focused on renewable energies. A part of the course will be dedicated to international research programs suitable to promote and/or fund students' placements in research institutes operating in the energy sector.

In particular, the course will provide specific knowledge on a broad range of novel materials used in different energy applications for production and energy saving, already available on the market or under development. These include aerogels as insulating systems for energy saving, new materials for retro-fitting of energy-efficient buildings, innovative ceramics for the production and conversion of energy by using solid fuel oxide cells; materials obtained from municipal solid waste incinerator ash and other combustion ash or industrial waste, just to name a few.

The course has two main objectives: first, to provide additional knowledge to what acquired in the course "Materials Science and Technology" (Bachelor); second, to help the future engineer in selecting the most suitable material/technique for efficient use of energy resources (renewable and not), with particular attention to materials' recycling and to the reduction of environmental impact. Furthermore, there will be a focus on composite materials used in energy applications, on their joining and integration with traditional materials.

Expected Learning: updated knowledge of new materials (either already available on the market or under development) for energy production and saving. The knowledge will focus on several advanced materials not studied in other courses, which are mandatory for the professional career of a future engineer. In particular, the student will be able to exploit his/her skills by *projects/case-studies, industrial problem-solving* examples to funding institution, stakeholders and companies in the energy field.

Assessment and Grading Criteria: Individual oral test. The test regards the evaluation of the know-how and skills developed during classes and during individual activities (case studies, problem solving, individual projects).

Prerequisites/Assumed Knowledge: Materials Science and Technology, Physics, Chemistry

Contents

1. Insulating materials for energy saving: aerogels, vacuum panels; retro-fitting of building, reflective/photo-thermo chromic glasses (6h)
2. Materials for photovoltaic energy production: from first to fourth generation photovoltaic cells, surface texturing, surface treatments (4h)
3. Materials for concentrated solar power plants (2 h)
4. Materials for fuel cells: Proton Exchange Membrane Fuel Cells, Solid Oxide Fuel Cells, Solid Oxide Electrolysis Cells: ceramics, glass-ceramics, steels and protective coatings (6 h)
5. Materials for Energy Storage and Conversion: supercapacitors, thermoelectrics, piezoelectrics; materials for oil&gas (4h)
6. Materials for power plants: super-alloys, ODS steels, ceramic matrix composites for advanced turbines and combustion chambers, Environment and Thermal Barrier Coatings for turbines, Thermal protection systems and technologies. Manufacturing and integration techniques for advanced materials for extreme applications (6h)
7. Materials for renewable energy production: i.e. composite materials for wind mills, materials for energy production from tides (6h)
8. Recycling of waste from the production of energy: municipal solid waste incinerators, biomass ash (6h)
9. Case studies/problem solving: economy issues of energy production, technology readiness level related to energy production; renewable energy start-ups' international scenario; industrial training: if available, to be organized upon request on national and international sites on dedicated funds. (4h)
10. Hands-on laboratory activity (16 h): Design, processing and characterization of advanced materials for energy production and storage; manufacturing and characterization of advanced coatings for ceramic matrix composites; coating depositions: physical vapor deposition (RF sputtering), electrochemical deposition (EPD); non-destructive evaluation of mock-ups for energy application through micro-Ct and micro-structural assessment of defects by microscopical analysis (SEM, etc); materials selection data bases.

Delivery Modes
- 40 hours of lectures and 20 hours of hands-on laboratories.
- Case studies and problem-solving on relevant topics; visits at industrial premises.

Further Information: Urgent information regarding the course, exam, etc. will be communicated through the web portal of this course.

PERSONALIA

Aldo R. Boccaccini (FAU) – received Diels-Planck-Lecture 2017 that is awarded annually to "an outstanding scientist and established leader in the field of nano and surface science" by the Kiel Nano, Surface and Interface Science (KiNSIS). His lecture "Bioactive Materials and Biofabrication for Regenerating Tissues: Progress and Challenges" was delivered on June 7, 2017 in the framework of the 3rd European Symposium on Intelligent Materials in Kiel.

Aldo R. Boccaccini (FAU) became a member of the Scientific Committee of the Materials Science and Engineering Congress (MSE2018), one of the largest English speaking conferences in the field of material science and engineering. MSE2018 will be held on September 25-28, 2018, hosted by the DGM at TU Darmstadt. Special guest country at the Congress 2018 will be Argentina.

Nenad Filipovic (BioIRC) co-organised and co-chaired **SEECCM 2017-** an important regional 4th South-East European Conference on Computational Mechanics (Kragujevac, Serbia on July 3-5, 2017).

Fracture safety of double-porous hydroxyapatite biomaterials - the paper co-authored by TUW/WUT team: A. Dejaco, V.S. Komlev, J. Jaroszewicz, W. Swieszkowski, C. Hellmich in I.C.E. Journal Bioinspired, Biomimetic and Nanobiomaterials, **5**, 2016, pp. 24-36 has been **awarded with the Kajal Mallick Memorial** 2017 for the best paper in this journal in 2016.
http://www.icevirtuallibrary.com/doi/abs/10.1680/jbibn.15.00021 (see also: "News from WG3")

Vasil I. Kavardzhikov (IMBAS) chaired the Organizing Committee of the National Congress on Theoretical and Applied Mechanics (Sept. 6-10, 2017, Sofia, Bulgaria).

"Bioactive Glasses: Fundamentals, Technology and Applications" - co-edited by Aldo R Boccaccini (FAU), Delia S. Brauer (Jena, Germany) and Leena Hupa (Turku, Finnland) has been recently published by the Royal Society of Chemistry (UK). This book aims to bridge the different scientific communities associated with the field of bioactive glasses with focus on the materials science point of view.

KMM-VIN Members
(Institutions)

CORE MEMBERS

1. **AGH-UST** AGH-University of Science and Technology, Krakow, Poland
2. **BioIRC** Bioengineering Research and Developing Centre, Kragujevac**,** Serbia
3. **CIDETEC** Fundacion CIDETEC, Donostia/SanSebastián, Spain
4. **CISM Lab** Centro Internazionale di Scienze Meccaniche Spin-off, Udine, Italy
5. **DPS** Doosan Power Systems Ltd, Crawley, UK
6. **FRAUNHOFER** Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung e.V., Germany
   - **IFAM** Fraunhofer Institute for Manufacturing and Advanced Materials, Bremen,
   - **IFAM-DD** Fraunhofer Institute for Manufacturing and Advanced Materials, Dresden,
   - **IWM** Fraunhofer Institute for Mechanics of Materials, Freiburg, Germany
   - **IKTS** Fraunhofer Institute for Ceramic Technologies and Systems, Dresden,
7. **HGI** Haydale Graphene Industries PLC, Ammanford, UK
8. **IK4-TEKNIKER** Foundación TEKNIKER**,** Eibar, Spain
9. **IMBAS** Institute of Mechanics, Bulgarian Academy of Sciences, Sophia, Bulgaria
10. **IMIM** Institute of Metallurgy and Materials Science, Pol. Acad. Sciences, Krakow**,** Poland
11. **IMRSAS** Institute of Materials Research, Slovak Academy of Sciences, Kosice, Slovakia
12. **INTA** Instituto Nacional de Técnica Aeroespacial, Torrejón de Ardoz, Spain
13. **IOD** Foundry Research Institute, Krakow, Poland
14. **IPM** Institute of Physics of Materials, Brno, Czech Republic
15. **IPPT** Institute of Fundamental Technological Research, Pol. Acad.Sciences, Warsaw, Poland
16. **ITC** Instituto de Tecnología Cerámica - AICE, Castellón, Spain
17. **ITME** Institute of Electronic Materials Technology, Warsaw, Poland
18. **MCL** Werkstoff-Kompetenzzentrum-Leoben Forschungsgesellschaft m.b.H. (Materials Centre Leoben), Leoben, Austria
19. **POLIMI** Politecnico di Milano, Milano, Italy
20. **POLITO** Politecnico di Torino, Torino, Italy
21. **R-TECH** Steinbeis Advanced Risk Technologies GmbH, Stuttgart, Germany
22. **TECNALIA** Fundación Tecnalia, Donostia-San Sebastian, Spain
23. **TUD** Technische Universität Darmstadt, Darmstadt, Germany
24. **TUG** Graz University of Technology, Graz, Austria
25. **TUW** Technische Universität Wien, Wien, Austria
26. **UH** University of Hertfordshire, Hatfield, Herts, UK
27. **UNIVPM** Università Politecnica delle Marche, Ancona, Italy
28. **UPM** Universidad Politécnica de Madrid, Madrid, Spain
29. **WRUT** Wroclaw University of Technology, Wroclaw, Poland
30. **WUT** Warsaw University of Technology, Warsaw, Poland

ASSOCIATE MEMBERS

1.	**ALSTOM**	Alstom Power Ltd., Rugby, UK
2.	**BEG**	Böhler Edelstahl GmbH & Co KG, Kapfenberg, Austria
3.	**BSGA**	Böhler Schweißtechnik Austria GmbH, Kapfenberg, Austria
4.	**BUDERUS**	Buderus Edelstahl GmbH, Wetzlar, Germany
5.	**CRF**	Centro Ricerche FIAT, Orbassano, Italy
6.	**CSM**	Centro Sviluppo Materiali S.p.A., Rome, Italy
7.	**DTU**	DTU Mechanical Engineering, Lyngby, Denmark
8.	**EMPA**	Materials Science and Technology, Dübendorf, Switzerland
9.	**E.ON**	E.ON New Build & Technology Ltd., Coventry, UK
10.	**ETE**	Energietechnik Essen GmbH, Essen, Germany
11.	**EU-VRi**	European Virtual Institute for Integrated Risk Management, Stuttgart, Germany
12.	**FAU**	Friedrich-Alexander Universität Erlangen-Nürnberg, Germany
13.	**GSCLtd**	Goodwin Steel Castings Ltd, Hanley, UK
14.	**ISPL**	Instytut Spawalnictwa, Gliwice, Poland
15.	**LU**	Loughborough University, Loughborough, UK
16.	**MPA**	Materialprüfungsanstalt Universität Stuttgart, Germany
17.	**NOMASICO**	Nomasico Ltd, Nikosia, Cyprus
18.	**NUIG**	National University of Ireland, Galway, Ireland
19.	**NTUA**	National Technical University of Athens, Athens, Greece
20.	**SIEMENS**	Siemens AG, München, Germany
21.	**SSF**	Saarschmiede GmbH Freiformschmiede, Völklingen, Germany
22.	**SVUM**	SVÚM a.s., Prague, Czech Republic
23.	**SWG**	Schmiedewerke Gröditz GmbH, Gröditz, Germany
24.	**TUC**	Chemnitz University of Technology, Chemnitz, Germany
25.	**TUDD**	Technische Universität Dresden, Germany
26.	**TUBAF**	TU Bergakademie Freiberg, Germany
27.	**UCM**	Universidad Complutense de Madrid, Spain
28.	**UL**	University of Limerick, Limerick, Ireland
29.	**UNIPAD**	Università degli Studi di Padova, Padova, Italy
30.	**VAGL**	Voestalpine Giesserei Linz GmbH, Linz, Austria
31.	**VGTU**	Vilnius Gediminas Technical University, Vilnius, Lithuania
32.	**V&MD**	Vallourec & Mannesmann Tubes, V&M Deutschland GmbH, Düsseldorf, Germany
33.	**VSB**	Technical University of Ostrava, Ostrava, Czech Republic
34.	**VTT**	VTT Technical Research Centre of Finland, Espoo, Finland
35.	**VZU**	Výzkumný a zkušební ústav Plzeň s.r.o., Plzeň, Czech Republic

INDIVIDUAL MEMBERS

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